Wireless LAN Mobility System
Wireless LAN Switch and Controller Configuration Guide

WX4400	3CRWX440095A
WX2200	3CRWX220095A
WX1200	3CRWX120695A
WXR100	3CRWXR10095A

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GLOSSARY

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COMMAND INDEX

ABOUT THIS GUIDE

This guide describes the configuration commands for the 3Com Wireless LAN Switch WXR100, WX1200, or 3Com Wireless LAN Controller WX4400, WX2200.

This guide is intended for System integrators who are configuring the WXR100, WX1200, WX4400, or WX2200.

If release notes are shipped with your product and the information there differs from the information in this guide, follow the instructions in the release notes.

Most user guides and release notes are available in Adobe Acrobat Reader Portable Document Format (PDF) or HTML on the 3Com World Wide Web site:

`http://www.3com.com/`

Conventions

Table 1 and Table 2 list conventions that are used throughout this guide.

Table 1 Notice Icons

Icon	Notice Type	Description
ℹ	Information note	Information that describes important features or instructions
⚠	Caution	Information that alerts you to potential loss of data or potential damage to an application, system, or device

This manual uses the following text and syntax conventions:

Table 2 Text Conventions

Convention	Description
`Monospace text`	Sets off command syntax or sample commands and system responses.
Bold text	Highlights commands that you enter or items you select.
Italic text	Designates command variables that you replace with appropriate values, or highlights publication titles or words requiring special emphasis.
[ ] (square brackets)	Enclose optional parameters in command syntax.
{ } (curly brackets)	Enclose mandatory parameters in command syntax.
| (vertical bar)	Separates mutually exclusive options in command syntax.
Keyboard key names	If you must press two or more keys simultaneously, the key names are linked with a plus sign (+). Example: Press Ctrl+Alt+Del
Words in *italics*	Italics are used to: ■ Emphasize a point. ■ Denote a new term at the place where it is defined in the text. ■ Highlight an example string, such as a username or SSID.

Documentation

The MSS documentation set includes the following documents.

- *Wireless Switch Manager (3WXM) Release Notes*

  These notes provide information about the 3WXM software release, including new features and bug fixes.

- *Wireless LAN Switch and Controller Release Notes*

  These notes provide information about the MSS software release, including new features and bug fixes.

- *Wireless LAN Switch and Controller Quick Start Guide*

  This guide provides instructions for performing basic setup of secure (802.1X) and guest (WebAAA™) access, for configuring a Mobility Domain for roaming, and for accessing a sample network plan in 3WXM for advanced configuration and management.

- *Wireless Switch Manager Reference Manual*

  This manual shows you how to plan, configure, deploy, and manage a Mobility System wireless LAN (WLAN) using the 3Com Wireless Switch Manager (3WXM).

- *Wireless Switch Manager User's Guide*

  This manual shows you how to plan, configure, deploy, and manage the entire WLAN with the 3WXM tool suite. Read this guide to learn how to plan wireless services, how to configure and deploy 3Com equipment to provide those services, and how to optimize and manage your WLAN.

- *Wireless LAN Switch and Controller Hardware Installation Guide*

  This guide provides instructions and specifications for installing a WX wireless switch in a Mobility System WLAN.

- *Wireless LAN Switch and Controller Configuration Guide*

  This guide provides instructions for configuring and managing the system through the Mobility System Software (MSS) CLI.

- *Wireless LAN Switch and Controller Command Reference*

  This reference provides syntax information for all MSS commands supported on WX switches.

Documentation Comments

Your suggestions are very important to us. They will help make our documentation more useful to you. Please e-mail comments about this document to 3Com at:

pddtechpubs_comments@3com.com

Please include the following information when contacting us:

- *Document title*
- *Document part number and revision (on the title page)*
- *Page number (if appropriate)*

Example:

- *Wireless LAN Switch and Controller Configuration Guide*
- *Part number 730-9502-0071, Revision B*
- *Page 25*

Please note that we can only respond to comments and questions about 3Com product documentation at this e-mail address. Questions related to technical support or sales should be directed in the first instance to your network supplier.

1

USING THE COMMAND-LINE INTERFACE

Mobility System Software (MSS) operates a 3Com Mobility System wireless LAN (WLAN) consisting of 3Com Wireless Switch Manager software, Wireless LAN Switches (WX1200 or WXR100), Wireless LAN Controllers (WX4400 or WX2200), and Managed Access Points (MAPs). MSS has a command-line interface (CLI) on a WX switch that you can use to configure and manage the switch and its attached MAPs.

Overview

You configure the WX switch and MAPs primarily with **set**, **clear**, and **display** commands. Use **set** commands to change parameters. Use **clear** commands to reset parameters to their defaults. In many cases, you can overwrite a parameter with another **set** command. Use **display** commands to display the current configuration and monitor the status of network operations.

The WX switch supports two connection modes:

- Administrative access mode, which enables the network administrator to connect *to* the WX and configure the network
- Network access mode, which enables network users to connect *through* the WX to access the network

CLI Conventions

Be aware of the following MSS CLI conventions for command entry:

- "Command Prompts" on page 28
- "Syntax Notation" on page 28
- "Text Entry Conventions and Allowed Characters" on page 28
- "User Globs, MAC Address Globs, and VLAN Globs" on page 30
- "Port Lists" on page 32
- "Virtual LAN Identification" on page 33

Command Prompts

By default, the MSS CLI provides the following prompt for restricted users. The *mmmm* portion shows the WX model number (for example, 1200) and the *nnnnnn* portion shows the last 6 digits of the WX media access control (MAC) address.

```
WXmmmm>
```

After you become enabled as an administrative user by typing **enable** and supplying a suitable password, MSS displays the following prompt:

```
WXmmmm#
```

For information about changing the CLI prompt on a WX, see the **set prompt** command description in the *Wireless LAN Switch and Controller Command Reference*.

Syntax Notation

The MSS CLI uses standard syntax notation:

- Bold monospace font identifies the command and keywords you must type. For example:

  ```
  set enablepass
  ```

- Italic monospace font indicates a placeholder for a value. For example, you replace *vlan-id* in the following command with a virtual LAN (VLAN) ID:

  ```
  clear interface vlan-id ip
  ```

- Curly brackets ({ }) indicate a mandatory parameter, and square brackets ([ ]) indicate an optional parameter. For example, you must enter **dynamic** or **port** and a port list in the following command, but a VLAN ID is optional:

  ```
  clear fdb {dynamic | port port-list} [vlan vlan-id]
  ```

- A vertical bar (|) separates mutually exclusive options within a list of possibilities. For example, you enter either **enable** or **disable**, not both, in the following command:

  ```
  set port {enable | disable} port-list
  ```

Text Entry Conventions and Allowed Characters

Unless otherwise indicated, the MSS CLI accepts standard ASCII alphanumeric characters, except for tabs and spaces, and is case-insensitive.

The CLI has specific notation requirements for MAC addresses, IP addresses, and masks, and allows you to group usernames, MAC addresses, virtual LAN (VLAN) names, and ports in a single command.

3Com recommends that you do not use the same name with different capitalizations for VLANs or access control lists (ACLs). For example, do not configure two separate VLANs with the names *red* and *RED*.

The CLI does not support the use of special characters including the following in any named elements such as SSIDs and VLANs: ampersand (&), angle brackets (< >), number sign (#), question mark (?), or quotation marks (“ ”).

In addition, the CLI does not support the use of international characters such as the accented *É* in DÉCOR.

MAC Address Notation

MSS displays MAC addresses in hexadecimal numbers with a colon (:) delimiter between bytes—for example, 00:01:02:1a:00:01. You can enter MAC addresses with either hyphen (-) or colon (:) delimiters, but colons are preferred.

For shortcuts:

- You can exclude leading zeros when typing a MAC address. MSS displays of MAC addresses include all leading zeros.
- In some specified commands, you can use the single-asterisk (*) wildcard character to represent an entire MAC address or from 1 byte to 5 bytes of the address. (For more information, see “MAC Address Globs” on page 31.)

IP Address and Mask Notation

MSS displays IP addresses in dotted decimal notation—for example, 192.168.1.111. MSS makes use of both subnet masks and wildcard masks.

Subnet Masks Unless otherwise noted, use classless interdomain routing (CIDR) format to express subnet masks—for example, 192.168.1.112/24. You indicate the subnet mask with a forward slash (/) and specify the number of bits in the mask.

Wildcard Masks Security access control lists (ACLs) use source and destination IP addresses and wildcard masks to determine whether the WX filters or forwards IP packets. Matching packets are either permitted or denied network access. The ACL checks the bits in IP addresses that correspond to any *0*s (zeros) in the mask, but does not check the bits that correspond to *1*s (ones) in the mask. You specify the wildcard mask in dotted decimal notation.

For example, the address 10.0.0.0 and mask 0.255.255.255 match all IP addresses that begin with 10 in the first octet.

The ACL mask must be a contiguous set of zeroes starting from the first bit. For example, 0.255.255.255, 0.0.255.255, and 0.0.0.255 are valid ACL masks. However, 0.255.0.255 is not a valid ACL mask.

User Globs, MAC Address Globs, and VLAN Globs

Name “globbing” is a way of using a wildcard pattern to expand a single element into a list of elements that match the pattern. MSS accepts user globs, MAC address globs, and VLAN globs. The order in which globs appear in the configuration is important, because once a glob is matched, processing stops on the list of globs

User Globs

A user glob is shorthand method for matching an authentication, authorization, and accounting (AAA) command to either a single user or a set of users.

A user glob can be up to 80 characters long and cannot contain spaces or tabs. The double-asterisk (**) wildcard characters with no delimiter characters match *all* usernames. The single-asterisk (*) wildcard character matches any number of characters up to, but not including, a delimiter character in the glob. Valid user glob delimiter characters are the *at* (@) sign and the period (.).

For example, in Table 3, the following globs identify the following users:

Table 3 User Globs

User Glob	User(s) Designated
jose@example.com	User *jose* at example.com

Table 3 User Globs (continued)

User Glob	User(s) Designated
*@example.com	All users at example.com whose usernames do not contain periods—for example, *jose@example.com* and *tamara@example.com,* but not *nin.wong@example.com,* because nin.wong contains a period
*@marketing.example.com	All marketing users at example.com whose usernames do not contain periods
.@marketing.example.com	All marketing users at example.com whose usernames contain a period
*	All users with usernames that have no delimiters
EXAMPLE*	All users in the Windows Domain EXAMPLE with usernames that have no delimiters
EXAMPLE*.*	All users in the Windows Domain EXAMPLE whose usernames contain a period
**	All users

MAC Address Globs

A media access control (MAC) address glob is a similar method for matching some authentication, authorization, and accounting (AAA) and forwarding database (FDB) commands to one or more 6-byte MAC addresses. In a MAC address glob, you can use a single asterisk (*) as a wildcard to match *all* MAC addresses, or as follows to match from 1 byte to 5 bytes of the MAC address:

```
00:*
00:01:*
00:01:02:*
00:01:02:03:*
00:01:02:03:04:*
```

For example, the MAC address glob 02:06:8c* represents all MAC addresses starting with 02:06:8c. Specifying only the first 3 bytes of a MAC address allows you to apply commands to MAC addresses based on an organizationally unique identity (OUI).

VLAN Globs

A VLAN glob is a method for matching one of a set of local rules on a WX switch, known as the location policy, to one or more users. MSS compares the VLAN glob, which can optionally contain wildcard characters, against the VLAN-Name attribute returned by AAA, to determine whether to apply the rule.

To match *all* VLANs, use the double-asterisk (**) wildcard characters with no delimiters. To match any number of characters up to, but not including, a delimiter character in the glob, use the single-asterisk (*) wildcard. Valid VLAN glob delimiter characters are the *at* (@) sign and the period (.).

For example, the VLAN glob *bldg4.** matches *bldg4.security* and *bldg4.hr* and all other VLAN names with *bldg4.* at the beginning.

Matching Order for Globs

In general, the order in which you enter AAA commands determines the order in which MSS matches the user, MAC address, or VLAN to a glob. To verify the order, view the output of the **display aaa** or **display config** command. MSS checks globs that appear higher in the list before items lower in the list and uses the first successful match.

Port Lists

The physical Ethernet ports on a WX can be set for connection to MAPs, authenticated wired users, or the network backbone. You can include a single port or multiple ports in one MSS CLI command by using the appropriate list format.

The ports on a WX are numbered 1 through as high as 22, depending on the WX model. No port 0 exists on the WX. You can include a single port or multiple ports in a command that includes **port** *port-list*. Use one of the following formats for *port-list*:

- A single port number. For example:

  ```
  WX1200# set port enable 6
  ```

- A comma-separated list of port numbers, with no spaces. For example:

  ```
  WX1200# display port poe 1,2,4,6
  ```

- A hyphen-separated range of port numbers, with no spaces. For example:

  ```
  WX1200# reset port 1-8
  ```

- Any combination of single numbers, lists, and ranges. Hyphens take precedence over commas. For example:

  ```
  WX1200# display port status 1-3,5
  ```

Virtual LAN Identification

The *names* of virtual LANs (VLANs), which are used in Mobility Domain™ communications, are set by you and can be changed. In contrast, VLAN ID *numbers*, which the WX switch uses locally, are determined when the VLAN is first configured and cannot be changed. Unless otherwise indicated, you can refer to a VLAN by either its VLAN name or its VLAN number. CLI **set** and **display** commands use a VLAN's name or number to uniquely identify the VLAN within the WX switch.

Command-Line Editing

MSS editing functions are similar to those of many other network operating systems.

Keyboard Shortcuts

Table 4 lists the keyboard shortcuts available for entering and editing CLI commands.

Table 4 CLI Keyboard Shortcuts

Keyboard Shortcut(s)	Function
Ctrl+A	Jumps to the first character of the command line.
Ctrl+B or Left Arrow key	Moves the cursor back one character.
Ctrl+C	Escapes and terminates prompts and tasks.
Ctrl+D	Deletes the character at the cursor.
Ctrl+E	Jumps to the end of the current command line.
Ctrl+F or Right Arrow key	Moves the cursor forward one character.
Ctrl+K	Deletes from the cursor to the end of the command line.
Ctrl+L or Ctrl+R	Repeats the current command line on a new line.
Ctrl+N or Down Arrow key	Enters the next command line in the history buffer.
Ctrl+P or Up Arrow key	Enters the previous command line in the history buffer.
Ctrl+U or Ctrl+X	Deletes characters from the cursor to the beginning of the command line.
Ctrl+W	Deletes the last word typed.
Esc B	Moves the cursor back one word.
Esc D	Deletes characters from the cursor forward to the end of the word.
Delete key or Backspace key	Erases mistake made during command entry. Reenter the command after using this key.

History Buffer

The history buffer stores the last 63 commands you entered during a terminal session. You can use the Up Arrow and Down Arrow keys to select a command that you want to repeat from the history buffer.

Tabs

The MSS CLI uses the Tab key for command completion. You can type the first few characters of a command and press the Tab key to display the command(s) that begin with those characters. For example:

```
WX1200# display i <Tab>
ifm        display interfaces maintained by the interface manager
igmp       display igmp information
interface  display interfaces
ip         display ip information
```

Single-Asterisk (*) Wildcard Character

You can use the single-asterisk (*) wildcard character in globbing. (For details, see "User Globs, MAC Address Globs, and VLAN Globs" on page 30.)

Double-Asterisk (**) Wildcard Characters

The double-asterisk (**) wildcard character matches all usernames. For details, see "User Globs" on page 30.

Using CLI Help

The CLI provides online help. To see the full range of commands available at your access level, type the following command:

```
WX1200# help
Commands:
-----------------------------------------------------------------------
clear                     Clear, use 'clear help' for more information
commit                    Commit the content of the ACL table
copy                      Copy from filename (or url) to filename (or url)
crypto                    Crypto, use 'crypto help' for more information
delete                    Delete url
dir                       display list of files on flash device
disable                   Disable privileged mode
display                   Display, use 'display help' for more information
help                      display this help screen
history                   display contents of history substitution buffer
load                      Load, use 'load help' for more information
logout                    Exit from the Admin session
monitor                   Monitor, use 'monitor help' for more information
ping                      Send echo packets to hosts
quit                      Exit from the Admin session
reset                     Reset, use 'reset help' for more information
```

```
rollback               Remove changes to the edited ACL table
save                   Save the running configuration to persistent storage
set                    Set, use 'set help' for more information
telnet                 telnet IP address [server port]
traceroute             Print the route packets take to network host
```

For more information on help, see the **help** command description in the *Wireless LAN Switch and Controller Command Reference*.

To see a subset of the online help, type the command for which you want more information. For example, the following command displays all the commands that begin with the letter *i*:

```
WX1200# display i?
ifm                   display interfaces maintained by the interface manager
igmp                  display igmp information
interface             display interfaces
ip                    display ip information
```

To see all the variations, type one of the commands followed by a question mark (?). For example:

```
WX1200# display ip ?
alias                 display ip aliases
dns                   display DNS status
https                 display ip https
route                 display ip route table
telnet                display ip telnet
```

To determine the port on which Telnet is running, type the following command:

```
WX1200# display ip telnet
Server Status                 Port
----------------------------------
Enabled                        3
```

Understanding Command Descriptions

Each command description in the *Wireless LAN Switch and Controller Command Reference* contains the following elements:

- A command name, which shows the keywords but not the variables. For example, the following command name appears at the top of a command description and in the index:

  set ap

  The **set ap** name command has the following complete syntax:

  ```
  set ap {apnumber | auto | security}
  ```
- A brief description of how the command functions.
- The full command syntax.
- Any command defaults.
- The command access, which is either *enabled* or *all*. *All* indicates that anyone can access this command. *Enabled* indicates that you must enter the enable password before entering the command.
- The command history, which identifies the MSS version in which the command was introduced and the version numbers of any subsequent updates.
- Special tips for command usage. These are omitted if the command requires no special usage.
- One or more examples of the command in context, with the appropriate system prompt and response.
- One or more related commands.

2

WX SETUP METHODS

This chapter describes the methods you can use to configure a WX switch, and refers you to information for each method. Depending on your configuration needs, you can use one or a combination of these methods.

For easy installation, use one of the quick-start methods described in this chapter instead of using the CLI instructions in later chapters in the manual.

Overview

MSS provides the following quick-start methods for new (unconfigured) switches:

- Web Quick Start (WXR100, WX1200, and WX2200)
- CLI **quickstart** command

You can use either quick-start method to configure a switch to provide wireless service. You also can use any of the following management applications to configure a new switch or to continue configuration of a partially configured switch:

- 3Com Wireless Switch Manager
- CLI
- Web Manager

Quick Starts

The Web Quick Start enables you to easily configure a WXR100, WX1200 or WX2200 switch to provide wireless access to up to 10 users. The Web Quick Start is accessible only on unconfigured WXR100, WX1200 or WX2200 switches. The interface is not available on other switch models or on any switch that is already configured.

The **quickstart** command enables you to configure a WXR100 switch to provide wireless access to any number of users.

3Com Wireless Switch Manager

You can use 3Com Wireless Switch Manager to remotely configure a switch using one of the following techniques:

- Drop ship—On model WXR100 only, you can press the factory reset switch during power on until the right LED above port 1 flashes for 3 seconds. Activating the factory reset causes the WXR100 to bypass the Web Quick Start and request its configuration from 3Com Wireless Switch Manager instead.
- Staged WX—On any switch model, you can stage the switch to request its configuration from 3Com Wireless Switch Manager, by preconfiguring IP parameters and enabling the auto-config option.

(These options are described in more detail in "Remote WX Configuration" on page 49.)

You also can use 3Com Wireless Switch Manager to plan your network, create WX switches in the plan, then deploy the switch configurations to the real switches. For information, see the following:

- *Wireless Switch Manager User's Guide*
- *Wireless Switch Manager Reference Manual*

To open a sample network plan, see "Opening the QuickStart Network Plan in 3Com Wireless Switch Manager" on page 49.

CLI

You can configure a switch using the CLI by attaching a PC to the switch's Console port.

After you configure the switch for SSH or Telnet access, you also can use these protocols to access the CLI.

Web Manager

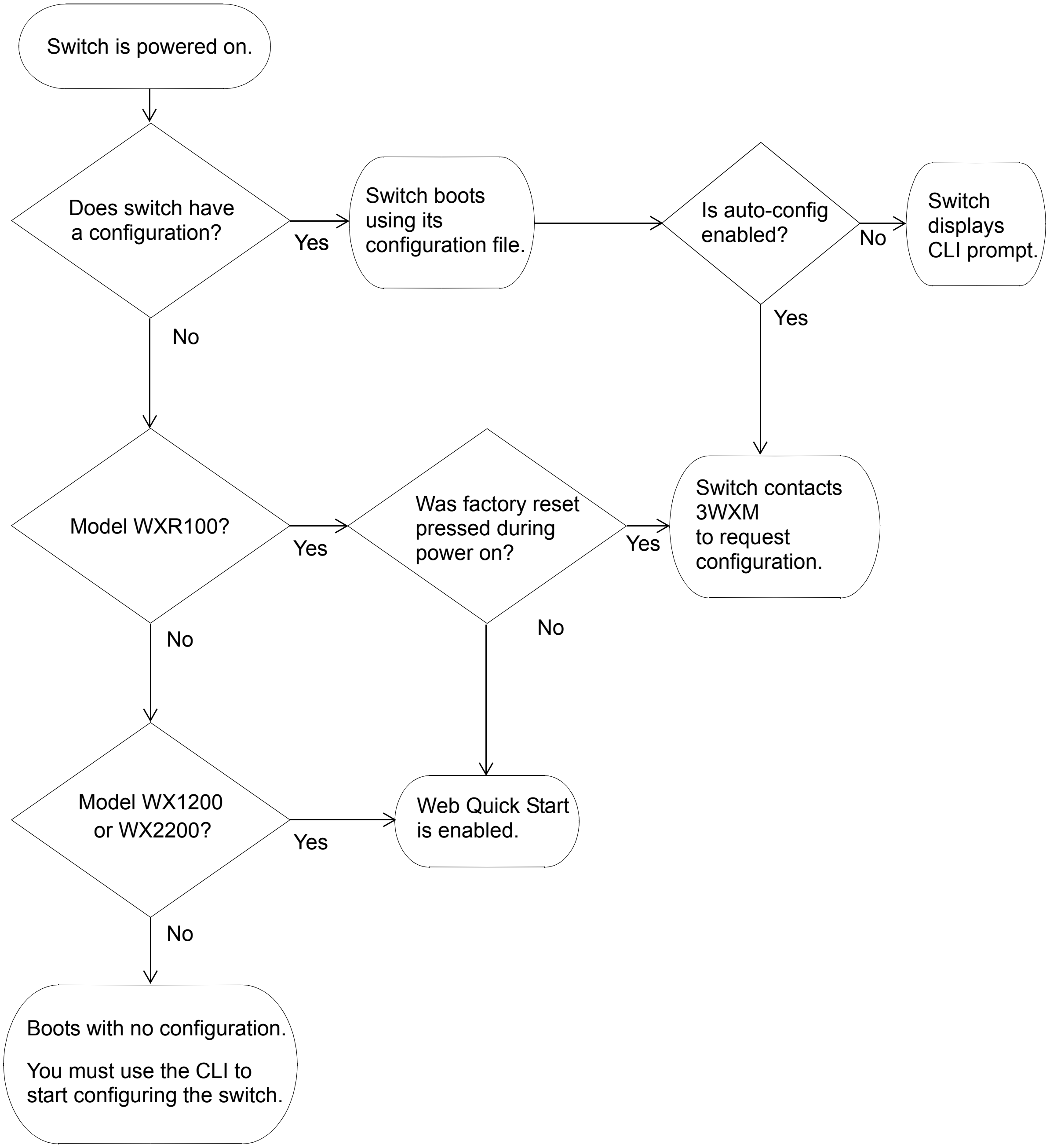
You can use a switch web management interface, Web Manager, to configure the switch. For access information, see Appendix B, "Logging Into Web View" on page 650.

Web Manager is different from the Web Quick Start application. Web Manager is a web-based management application that is available at any time on a switch that already has IP connectivity. (Web Manager access also requires the switch's HTTPS server to be enabled.) The Web Quick Start application is accessible only on unconfigured switches.

How a WX Switch Gets its Configuration

Figure 1 shows how a WX switch gets a configuration when you power it on.

Figure 1 WX Switch Startup Algorithm


Switch is powered on.
Does switch have a configuration?
Yes
Switch boots using its configuration file.
Is auto-config enabled?
No
Switch displays CLI prompt.
Yes
No
Model WXR100?
Yes
Was factory reset pressed during power on?
Yes
Switch contacts 3WXM to request configuration.
No
No
Model WX1200 or WX2200?
Yes
Web Quick Start is enabled.
No
Boots with no configuration.
You must use the CLI to start configuring the switch.

Web Quick Start (WXR100, WX1200 and WX2200 Only)

You can use the Web Quick Start to configure the switch to provide wireless access to up to ten network users.

To access the Web Quick Start, attach a PC directly to port 1 or port 2 on the switch and use a web browser on the PC to access IP address 192.168.100.1. (For more detailed instructions, see "Accessing the Web Quick Start" on page 41.)

The Web Quick Start application is different from Web Manager. Web Manager is a web-based management application that is available at any time on a switch that already has IP connectivity. (Web Manager access also requires the switch's HTTPS server to be enabled.) The Web Quick Start application is accessible only on unconfigured switches.

The Web Quick Start application is supported only on switch models WXR100, WX1200, and WX2200. After you finish the Web Quick Start, it will not be available again unless you clear (erase) the switch's configuration.

Web Quick Start Parameters

The Web Quick Start enables you to configure basic wireless access for a small office. You can use the Web Quick Start to configure the following parameters:

- System name of the switch
- Country code (the country where wireless access will be provided)
- Administrator username and password
- Management IP address and default router (gateway)
- Time and date (statically configured or provided by an NTP server)
- Management access
- You can individually select Telnet, SSH, and Web View. You also can secure the Console port. Access requires the administrator username and password.
- Power over Ethernet (PoE), for ports directly connected to MAPs
- SSIDs and authentication types. The Web Quick Start enables you to configure one secure SSID and one clear SSID. You can configure additional SSIDs using the CLI or 3Com Wireless Switch Manager.
- Usernames and passwords for your wireless users. You can configure up to ten users with the Web Quick Start. To configure additional users, use the CLI or 3Com Wireless Switch Manager.

Web Quick Start Requirements

To use the Web Quick Start, you need the following:

- AC power source for the switch
- PC with an Ethernet port that you can connect directly to the switch
- Category 5 (Cat 5) or higher Ethernet cable

If the PC is connected to the network, power down the PC or disable its network interface card (NIC), then unplug the PC from the network.

You can use a Layer 2 device between the switch and the PC. However, do not attach the switch to your network yet. The switch requires the PC you attach to it for configuration to be in the 192.168.100.x subnet, and uses the MSS DHCP server to assign the PC an address from this subnet. If you attach the unconfigured switch to your network, the switch disables the MSS DHCP server, if the switch detects another DHCP server on the network. If the network does not have a DCHP server, the switch's DHCP server remains enabled and will offer IP addresses in the 192.168.100.x subnet in response to DHCP Requests.

Accessing the Web Quick Start

To access the Web Quick Start:

1 Use a Category 5 (Cat 5) or higher Ethernet cable to connect the switch directly to a PC that has a web browser.

2 Connect the switch to an AC power source.

If the green power LED is lit, the switch is receiving power.

If you are configuring a WXR100, do not press the factory reset switch during power on. Pressing this switch on an unconfigured switch causes the switch to attempt to contact a 3Com Wireless Switch Manager server instead of displaying the Web Quick Start. (Other switch models also have reset switches, but the reset switch simply restarts these other models without clearing the configuration.)

3 Enable the PC's NIC that is connected to the switch, if not already enabled.

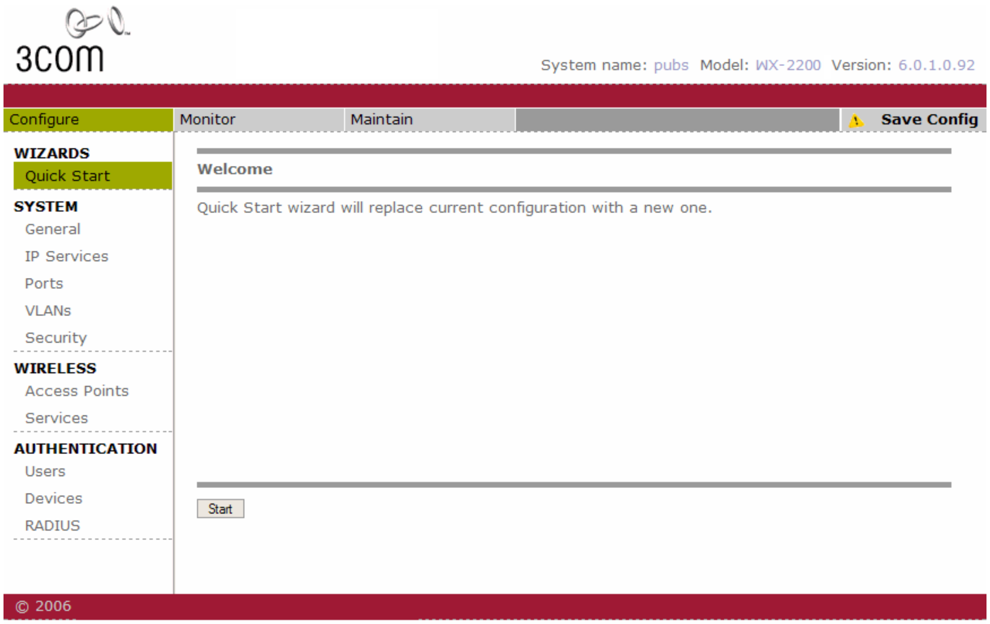
4 Verify that the NIC is configured to use DHCP to obtain its IP address.

You will not be able to access the Web Quick Start if the IP address of the NIC is statically configured.

5 Use a web browser to access IP address 192.168.100.1.

This is a temporary, well-known address assigned to the unconfigured switch when you power it on. The Web Quick Start enables you to change this address.

The first page of the Quick Start Wizard appears.


3com
Configure
Monitor
Maintain
Save Config
WIZARDS
Quick Start
SYSTEM
General
IP Services
Ports
VLANs
Security
WIRELESS
Access Points
Services
AUTHENTICATION
Users
Devices
RADIUS
Welcome
Start
© 2006

System name: pubs Model: WX-2200 Version: 6.0.1.0.92

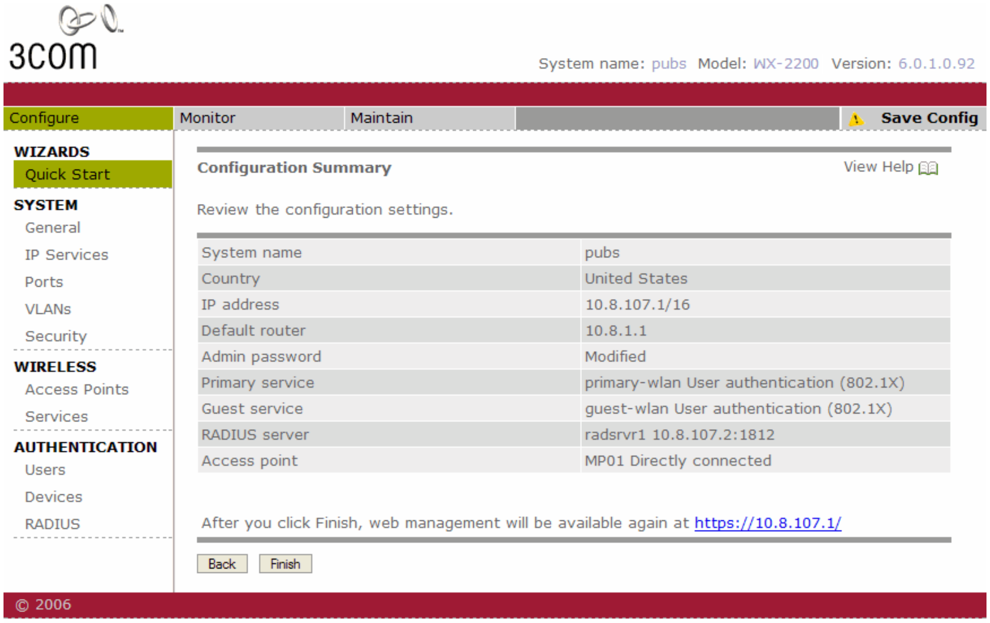
Quick Start wizard will replace current configuration with a new one.

6 Click **Start** to begin. The wizard screens guide you through the configuration steps.

CAUTION: *Use the wizard's* ***Next*** *and* ***Back*** *buttons to navigate among the wizard pages. Using the browser's navigation buttons, such as* ***Back*** *and* ***Forward****, can result in loss of information. Do not click the browser's* ***Refresh*** *or* ***Reload*** *button at any time while using the wizard. If you do click* ***Refresh*** *or* ***Reload****, all the information you have entered in the wizard will be cleared.*

7 After guiding you through the configuration, the wizard displays a summary of the configuration values you selected.

Here is an example:


3com
System name: pubs Model: WX-2200 Version: 6.0.1.0.92
Configure
Monitor
Maintain
Save Config
WIZARDS
Quick Start
SYSTEM
General
IP Services
Ports
VLANs
Security
WIRELESS
Access Points
Services
AUTHENTICATION
Users
Devices
RADIUS
View Help
Back
Finish
© 2006

Configuration Summary

Review the configuration settings.

System name	pubs
Country	United States
IP address	10.8.107.1/16
Default router	10.8.1.1
Admin password	Modified
Primary service	primary-wlan User authentication (802.1X)
Guest service	guest-wlan User authentication (802.1X)
RADIUS server	radsrvr1 10.8.107.2:1812
Access point	MP01 Directly connected

After you click Finish, web management will be available again at https://10.8.107.1/

8 Review the configuration settings, then click **Finish** to save the changes or click **Back** to change settings. If you want to quit for now and start over later, click **Cancel**.

If you click **Finish**, the wizard saves the configuration settings into the switch's configuration file. If the switch is rebooted, the configuration settings are restored when the reboot is finished.

The switch is ready for operation. You do not need to restart the switch.

CAUTION: On a WXR100, do not press the factory reset switch for more than four seconds! *On a WXR100 that is fully booted, the factory reset switch erases the configuration if held for five seconds or more. If you do accidentally erase the configuration, you can use the Web Quick Start to reconfigure the switch.*

CLI quickstart Command

The **quickstart** command runs a script that interactively helps you configure the following items:

- System name
- Country code (regulatory domain)
- System IP address
- Default route
- 802.1Q tagging for ports in the default VLAN
- Administrative users and passwords
- Enable password
- System time, date, and timezone
- Unencrypted (clear) SSID names
- Usernames and passwords for guest access using WebAAA
- Encrypted (crypto) SSID names and dynamic WEP encryption for encrypted SSIDs' wireless traffic
- Usernames and passwords for secure access using 802.1X authentication using PEAP-MSCHAP-V2 and secure wireless data encryption using dynamic Wired Equivalent Privacy (WEP)
- Directly connected MAPs
- Distributed MAPs

The **quickstart** command displays a prompt for each of these items, and lists the default if applicable. You can advance to the next item, and accept the default if applicable, by pressing Enter.

The command also automatically generates a key pair for SSH.

Depending on your input, the command also automatically generates the following key pairs and self-signed certificates:

- SSH key pair (always generated)
- Admin key pair and self-signed certificate (always generated)
- EAP (802.1X) key pair and self-signed certificate (generated if you type usernames and passwords for users of encrypted SSIDs)
- WebAAA key pair and self-signed certificate (generated if you type usernames and passwords for users of unencrypted SSIDs)

The command automatically places all ports that are not used for directly connected MAPs into the default VLAN (VLAN 1).

*The **quickstart** command prompts you for an administrative username and password for managing the switch over the network. The command automatically configures the same password as the switch's enable password. You can change the enable password later using the **set enablepass** command.*

***CAUTION:** The **quickstart** command is for configuration of a new switch only. After prompting you for verification, the command erases the switch's configuration before continuing. If you run this command on a switch that already has a configuration, the configuration will be erased. In addition, error messages such as Critical AP Notice for directly connected MAPs can appear.*

To run the **quickstart** command:

1. Attach a PC to the WX switch's serial console port. (Use these modem settings: 9600 bps, 8 bits, 1 stop, no parity, hardware flow control *disabled*.)
2. Press Enter three times, to display a username prompt (Username:), a password prompt (Password:), and then a command prompt such as the following:

   ```
   WX1200-aabbcc>
   ```

   (Each switch has a unique system name that contains the model number and the last half of the switch's MAC address.)
3. Access the *enabled* level (the configuration level) of the CLI:

   ```
   WX12000-aabbcc> enable
   ```
4. Press Enter at the Enter password prompt.
5. Type **quickstart**. The command asks you a series of questions. You can type **?** for more help. To quit, press **Ctrl**+**C**.

   One of the questions the script asks is the country code. For a list of valid country codes, see "Specifying the Country of Operation" on page 213.

   Another question the script asks is, "Do you wish to configure wireless?" If you answer **y**, the script goes on to ask you for SSID and user information, for unencrypted and encrypted SSIDs. If you answer **n**, the script generates key pairs for SSH and the administrative users you entered, generates a self-signed administrative certificate, and then ends.

Quickstart Example

This example configures the following parameters:

- System name: WX1200-Corp
- Country code (regulatory domain): US
- System IP address: 172.16.0.21, on IP interface 172.16.0.21 255.255.255.0

The ***quickstart*** *script asks for an IP address and subnet mask for the system IP address, and converts the input into an IP interface with a subnet mask, and a system IP address that uses that interface. Likewise, if you configure this information manually instead of using the* ***quickstart*** *command, you must configure the interface and system IP address separately.*

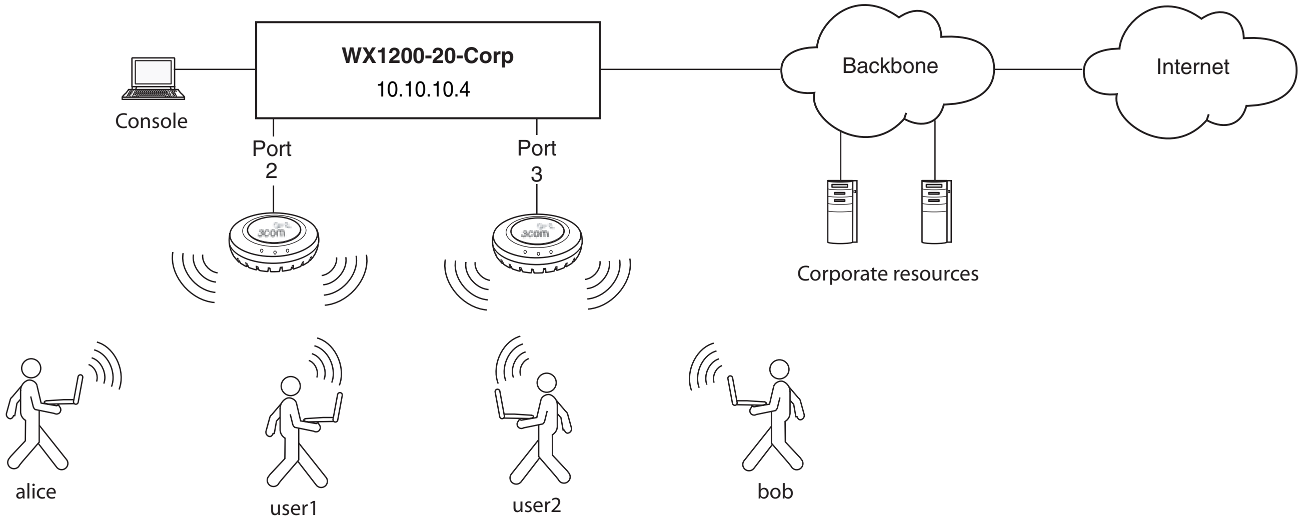
- Default route: 172.16.0.20
- Administrative user *wxadmin*, with password *letmein.* The only management access the switch allows by default is CLI access through the serial connection.
- System Time and date parameters:
  - Date: 31st of March, 2007
  - Time: 4:36 PM
  - Timezone: *PST* (Pacific Standard Time), with an offset of -8 hours from Universal Coordinated Time (UTC)
- Unencrypted SSID name: *public*
- Username *user1* and password *pass1* for WebAAA
- Encrypted SSID name: *corporate*
- Username *bob* and password *bobpass* for 802.1X authentication
- Directly connected MAPs on port 2, model AP2750

The IP addresses, usernames, and passwords in this document are examples. Use values that are appropriate for your organization.

If you configure time and date parameters, you will be required to enter a name for the timezone, and then enter the value of the timezone (the offset from UTC) separately. You can use a string of up to 32 alphabetic characters as the timezone name.

Figure 2 shows an example. Users *bob* and *alice* can access encrypted SSID *corporate* on either of the MAPs. Users *user1* and *user2* can use the same MAPs to access unencrypted SSID *public*. Although the same hardware supports both SSIDs and sets of users, AAA ensures that only the users who are authorized to access an SSID can access that SSID. Users of separate SSIDs can even be in the same VLAN, as they are in this example.

Figure 2 Single-Switch Deployment



```
WXR100-aabbcc# quickstart
This will erase any existing config. Continue? [n]: y
Answer the following questions. Enter '?' for help. ^C to
break out
System Name [WXR100]: WXR100-mrktg
Country Code [US]: US
System IP address []: 172.16.0.21
System IP address netmask []: 255.255.255.0
Default route []: 172.16.0.21
Do you need to use 802.1Q tagged default VLAN [Y/N]? Y: y
Specify the port number that needs to be tagged [1-2, <CR>
ends config]: 2
Specify the tagged value for port [2] [<CR> ends config:] 100
Specify the port number that needs to be tagged [1-2, <CR>
ends config]:
Admin username [admin]: wxadmin
Admin password [optional]: letmein
Enable password [optional]: enable
Do you wish to set the time? [y]: y
Enter the date (dd/mm/yy) []: 31/03/07
Is daylight saving time (DST) in effect [n]: n
Enter the time (hh:mm:ss) []: 04:36:20
Enter the timezone []: PST
Enter the offset (without DST) from GMT for 'PST' in hh:mm
[0:0]: -8:0
Do you wish to configure wireless? [y]: y
Enter a clear SSID to use: public
Do you want Web Portal authentication? [y]: y
Enter a username with which to do Web Portal, <cr> to exit:
user1
Enter a password for user1: user1pass1
Enter a username with which to do Web Portal, <cr> to exit:
Do you want to do 802.1x and PEAP-MSCHAPv2? [y]: y
Enter a crypto SSID to use: corporate
Enter a username with which to do PEAP-MSCHAPv2, <cr> to
exit: bob
Enter a password for bob: bobpass
Enter a username with which to do PEAP-MSCHAPv2, <cr> to exit:
Do you wish to configure access points? [y]: y
Enter a port number [1-2] on which an AP resides, <cr> to
exit: 2
Enter AP model on port 2: ap3750
Enter a port number [1-2] on which an AP resides, <cr> to exit:
Do you wish to configure distributed access points? [y]: y
Enter a DAP serial number, <cr> to exit: 0422700351
Enter model of DAP with S/N 0422700351: ap3750
Enter a DAP serial number, <cr> to exit:
success: created keypair for ssh
success: Type “save config” to save the configuration
WXR100-aabbcc# save config
```

6. Optionally, enable Telnet and enable the admin user to use Telnet.

```
WXR100-aabbcc# set ip telnet server enable
WXR100-aabbcc# set user wxadmin attr service-type 6
```

7. Verify the configuration changes.

```
WXR100-aabbcc# display config
```

8 Save the configuration changes.

```
WXR100-aabbcc# save config
```

Remote WX Configuration

You can use 3Com Wireless Switch Manager Services running in your corporate network to configure WX switches in remote offices. The following remote configuration scenarios are supported:

- Drop ship—3Com Wireless Switch Manager Services running in the corporate network can configure a WXR100 switch shipped directly to a remote office. This option does not require any preconfiguration of the switch.
- Staged—You can stage any model of switch by preconfiguring IP connectivity and enabling auto-config, then sending the switch to the remote office. The switch contacts 3Com Wireless Switch Manager Services in the corporate network to complete its configuration.

The drop ship option is supported only for the WXR100. The staged option is supported for all switch models. Both options require 3Com Wireless Switch Manager Services.

(For more information, see the “Configuring WX Switches Remotely” chapter in the *Wireless Switch Manager Reference Manual*.

Opening the QuickStart Network Plan in 3Com Wireless Switch Manager

3Com Wireless Switch Manager comes with two sample network plans:

- *QuickStart*—Contains a two-floor building with two WX switches and two MAPs on each switch. Each switch and its MAPs provide coverage for a floor. The 3Com equipment is configured to provide both clear (unencrypted) and secure (802.1X) wireless access.
- *StarterKit*—Contains a simple rectangle as a floor plan, but with one WX switch and four MAPs. You can modify this plan to deploy the 3Com starter kit (STR-B-xx).

The QuickStart network plan contains a configuration similar to the one created by the CLI **quickstart** example in “Quickstart Example” on page 46. The plan differs from the sample configuration by using separate VLANs for WX management traffic, corporate users, and guest users. Otherwise, the configuration is the same.

To open the network plan:

1. Install 3WXM, if not already installed. (See the “Getting Started” chapter of the *Wireless Switch Manager User’s Guide* or the “Installing 3WXM” chapter of the *Wireless Switch Manager Reference Manual*.)
2. Start 3WXM by doing one of the following:
   - On Windows systems, select **Start > Programs > 3Com > 3WXM > 3WXM**, or double-click the **3WXM** icon on the desktop.
   - On Linux systems, change directories to *3WXM_installation_directory*/bin, and enter **./3wxm**.

   If you are starting 3Com Wireless Switch Manager for the first time, or you have not entered license information previously, the License Information dialog box appears. Enter the serial number and License, then click **OK**.
3. When the 3Com Wireless Switch Manager Services Connection dialog appears, enter the IP address and UDP port of 3Com Wireless Switch Manager Services (if installed on a different machine than the client), and click **Next**.
4. If the Certificate Check dialog appears, click **Accept** to complete the connection to 3Com Wireless Switch Manager Services.
5. Select **File > Switch Network Plan**.
6. Click **Yes** to close the plan that is currently open.

   The Switch Network Plan dialog appears, listing the available network plans.
7. Select QuickStart and click **Next**.

3

CONFIGURING AAA FOR ADMINISTRATIVE AND LOCAL ACCESS

3Com Mobility System Software (MSS) supports authentication, authorization, and accounting (AAA) for secure network connections. As administrator, you must establish administrative access for yourself and optionally other local users before you can configure the WX for operation.

Overview

Here is an overview of configuration topics:

1. **Console connection**. By default, any administrator can connect to the console port and manage the switch, because no authentication is enforced. (3Com recommends that you enforce authentication on the console port after initial connection.)
2. **Telnet or SSH connection**. Administrators cannot establish a Telnet or Secure Shell (SSH) connection to the WX by default. To provide Telnet or SSH access, you must add a username and password entry to the local database or, optionally, set the authentication method for Telnet users to a Remote Authentication Dial-In User Service (RADIUS) server.

   A CLI Telnet connection to the WX is not secure, unlike SSH, 3WXM and Web Manager connections. (For details, see Chapter 20, "Managing Keys and Certificates," on page 413.)

3. **Restricted mode.** When you initially connect to the WX, your mode of operation is restricted. In this mode, only a small subset of status and monitoring commands is available. Restricted mode is useful for administrators with basic monitoring privileges who are not allowed to change the configuration or run traces.
4. **Enabled mode.** To enter the enabled mode of operation, you type the **enable** command at the command prompt. In enabled mode, you can use all CLI commands. Although MSS does not require an enable password, 3Com highly recommends that you set one.

5. **Customized authentication.** You can require authentication for all users or for only a subset of users. Username globbing (see "User Globs, MAC Address Globs, and VLAN Globs" on page 30) allows different users or classes of user to be given different authentication treatments. You can configure console authentication and Telnet authentication separately, and you can apply different authentication methods to each.

   For any user, authorization uses the same method(s) as authentication for that user.

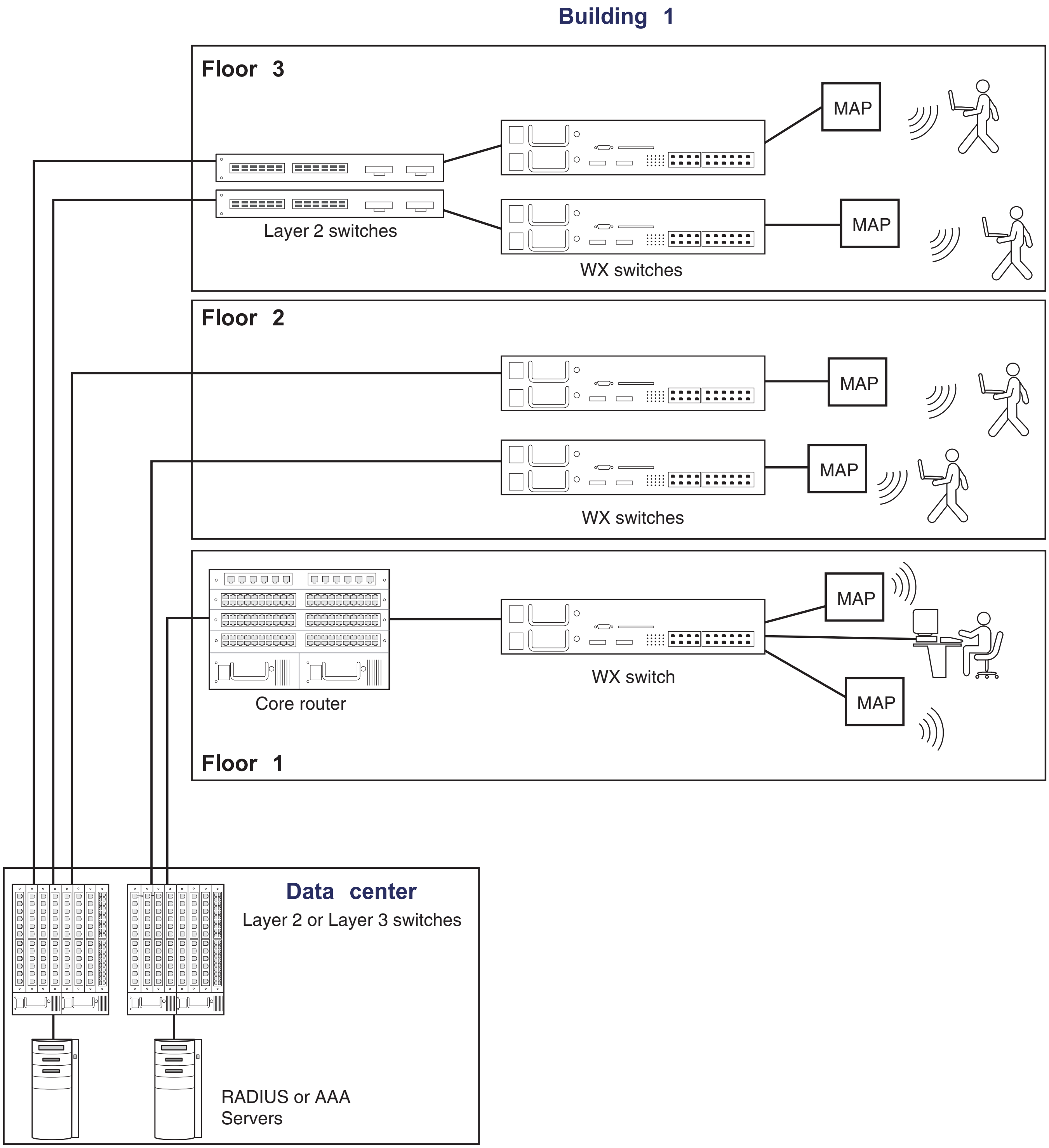
6. **Local override.** A special authentication technique called local override lets you attempt authentication via the local database before attempting authentication via a RADIUS server. The WX switch attempts administrative authentication in the local database first. If it finds no match, the WX attempts administrative authentication on the RADIUS server. (For information about setting a WX switch to use RADIUS servers, see Chapter 22, "Configuring Communication with RADIUS," on page 519.)

7. **Accounting for administrative access sessions.** Accounting records can be stored and displayed locally or sent to a RADIUS server. Accounting records provide an audit trail of the time an administrative user logged in, the administrator's username, the number of bytes transferred, and the time the session started and ended.

Figure 3 illustrates a typical WX switch, MAPs, and network administrator in an enterprise network. As network administrator, you initially access the WX switch via the console. You can then optionally configure authentication, authorization, and accounting for administrative access mode.

3Com recommends enforcing authentication for administrative access using usernames and passwords stored either locally or on RADIUS servers.

Figure 3 Typical 3Com Mobility System


Building 1
Floor 3
MAP
MAP
Layer 2 switches
WX switches
Floor 2
MAP
MAP
WX switches
MAP
Core router
WX switch
MAP
Floor 1
Data center
Layer 2 or Layer 3 switches
RADIUS or AAA
Servers

Before You Start

Before reading more of this chapter, read the *Wireless LAN Switch and Controller Quick Start Guide* to set up a WX switch and the attached MAPs for basic service.

About Administrative Access

The authentication, authorization, and accounting (AAA) framework helps secure network connections by identifying who the user is, what the user can access, and the amount of network resources the user can consume.

Access Modes

MSS provides AAA either locally or via remote servers to authenticate valid users. MSS provides two modes of access:

- **Administrative access mode** — Allows a network administrator to access the WX switch and configure it.

  You must establish administrative access in enabled mode before adding users. See "Enabling an Administrator" on page 55.
- **Network access mode** — Allows network users to connect through the WX switch. For information about configuring network users, see Chapter 21, "Configuring AAA for Network Users," on page 433.

Types of Administrative Access

MSS allows you access to the WX switch with the following types of administrative access:

- **Console** — Access via only the console port. For more information, see "First-Time Configuration via the Console" on page 55.
- **Telnet** — Users who access MSS via the Telnet protocol. For information about setting up a WX switch for Telnet access, see Chapter 6, "Configuring and Managing IP Interfaces and Services," on page 103.
- **Secure Shell (SSH)** — Users who access MSS via the SSH protocol. For information about setting up a WX switch for SSH access, see Chapter 6, "Configuring and Managing IP Interfaces and Services," on page 103.
- **3WXM** — After you configure the WX switch as described in this guide, you can further configure the WX switch using the 3WXM tool suite. For more information, see the *Wireless Switch Manager Reference Manual*.
- **Web View** — A Web-based application for configuring and managing a single WX switch through a Web browser. Web View uses a secure connection via Hypertext Transfer Protocol over Secure Sockets Layer (HTTPS).

First-Time Configuration via the Console

Administrators must initially configure the WX switch with a computer or terminal connected to the WX console port through a serial cable. Telnet access is not initially enabled.

To configure a previously unconfigured WX switch via the console, you must complete the following tasks:

- Enable an administrator. (See "Enabling an Administrator" on page 55.)
- Configure authentication. (See "Authenticating at the Console" on page 57.)
- Optionally, configure accounting. (see "Configuring Accounting for Administrative Users" on page 59.)
- Save the configuration. (See "Saving the Configuration" on page 61.)

Enabling an Administrator

To enable yourself as an administrator, you must log in to the WX switch from the console. Until you set the enable password and configure authentication, the default username and password are blank. Press Enter when prompted for them.

To enable an administrator:

1. Log in to the WX switch from the serial console, and press Enter when the WX switch displays a username prompt:

   ```
   Username:
   ```

2. Press Enter when the WX switch displays a password prompt.

   ```
   Password:
   ```

3. Type **enable** to go into enabled mode.

   ```
   WX1200> enable
   ```

4. Press Enter to display an enabled-mode command prompt:

   ```
   WX1200#
   ```

   Once you see this prompt after you have typed the **enable** command, you have administrative privileges, which allow you to further configure the WX switch.

Setting the WX Switch Enable Password

There is one enable password for the entire WX switch. You can optionally change the enable password from the default.

3Com recommends that you change the enable password from the default (no password) to prevent unauthorized users from entering configuration commands.

Setting the WX Enable Password for the First Time

To set the enable password for the first time:

1. At the enabled prompt, type **set enablepass.**
2. At the "Enter old password" prompt, press Enter.
3. At the "Enter new password" prompt, enter an enable password of up to 32 alphanumeric characters with no spaces. The password is not displayed as you type it.

   The enable password is case-sensitive.

4. Type the password again to confirm it.

   MSS lets you know the password is set.

```
WX1200# set enablepass
Enter old password:
Enter new password:
Retype new password:
Password changed
```

Be sure to use a password that you will remember. If you lose the enable password, the only way to restore it causes the system to return to its default settings and wipes out any saved configuration. (For details, see "Recovering the System When the Enable Password is Lost" on page 622.)

5. Store the configuration into nonvolatile memory by typing the following command:

```
WX1200# save config
success: configuration saved.
```

3WXM Enable Password

If you use 3WXM to continue configuring the switch, you will need to enter the switch's enable password when you upload the switch's configuration into 3WXM. (For 3WXM information, see the *Wireless Switch Manager Reference Manual*.)

Authenticating at the Console

You can configure the console so that authentication is required, or so that *no* authentication is required. 3Com recommends that you enforce authentication on the console port.

To enforce console authentication, take the following steps:

1. Add a user in the local database by typing the following command with a username and password:

```
WX1200# set user username password password
success: change accepted.
```

2. To enforce the use of console authentication via the local database, type the following command:

If you type this command before you have created a local username and password, you can lock yourself out of the WX *switch. Before entering this command, you must configure a local username and password.*

```
WX1200# set authentication console * local
```

3. To store this configuration into nonvolatile memory, type the following command:

```
WX1200# save config
success: configuration saved.
```

By default, no authentication is required at the console. If you have previously required authentication and have decided not to require it (during testing, for example), type the following command to configure the console so that it does *not* require username and password authentication:

```
WX1200# set authentication console * none
```

The authentication method ***none*** *you can specify for administrative access is different from the fallthru authentication type None, which applies only to network access. The authentication method* ***none*** *allows access to the WX switch by an administrator. The fallthru authentication type None denies access to a network user. (For information about the fallthru authentication types, see "Authentication Algorithm" on page 435.)*

Customizing AAA with "Globs" and Groups

"Globbing" lets you classify users by username or media access control (MAC) address for different AAA treatments. A user glob is a string, possibly containing wildcards, for matching AAA and IEEE 802.1X authentication methods to a user or set of users. The WX switch supports the following wildcard characters for user globs:

- Single asterisk (*) matches the characters in a username up to but not including a separator character, which can be an *at* (@) sign or a period (.).
- Double asterisk (**) matches all usernames.

In a similar fashion, MAC address globs match authentication methods to a MAC address or set of MAC addresses. For details, see "User Globs, MAC Address Globs, and VLAN Globs" on page 30.

A user group is a named collection of users or MAC addresses sharing a common authorization policy. For example, you might group all users on the first floor of building 17 into the group *bldg-17-1st-floor*, or group all users in the IT group into the group *infotech-people*. Individual user entries override group entries if they both configure the same attribute.

(For information about configuring users and user groups, see "Adding and Clearing Local Users for Administrative Access" on page 59.)

Setting User Passwords

Like usernames, passwords are case-sensitive. To make passwords secure, make sure they contain uppercase and lowercase letters and numbers. 3Com recommends that all users create passwords that are memorable to themselves, difficult for others to guess, and not subject to a dictionary attack.

User passwords are automatically encrypted when entered in the local database. However, the encryption is not strong. It is designed only to discourage someone looking over your shoulder from memorizing your password as you display the configuration. To maintain security, MSS displays only the encrypted form of the password in **display** commands.

Although MSS allows you to configure a user password for the special "last-resort" guest user, the password has no effect. Last-resort users can never access a WX in administrative mode and never require a password.

Adding and Clearing Local Users for Administrative Access

Usernames and passwords can be stored locally on the WX switch. 3Com recommends that you enforce console authentication after the initial configuration to prevent anyone with unauthorized access to the console from logging in. The local database on the WX switch is the simplest way to store user information in a 3Com system.

To configure a user in the local database, type the following command:

```
set user username password [encrypted] password
```

For example, to configure user Jose with the password *spRin9* in the local database on the WX switch, type the following command:

```
WX1200# set user Jose password spRin9
success: User Jose created
```

To clear a user from the local database, type the following command:

```
clear user username
```

Configuring Accounting for Administrative Users

Accounting allows you to track network resources. Accounting records can be updated for three important events: when the user is first connected, when the user roams from one MAP to another, and when the user terminates his or her session. The default for accounting is *off*.

To configure accounting for administrative logins, use the following command:

```
set accounting {admin | console} {user-glob}
{start-stop  | stop-only} method1 [method2] [method3]
[method4]
```

```
set accounting {admin | console} {user-glob}
{start-stop  | stop-only} method1 [method2] [method3]
[method4]
```

To configure accounting for administrative logins over the network at *EXAMPLE*, enter the following command:

```
set accounting admin EXAMPLE\*
{start-stop | stop-only} aaa-method
```

You can select either **start-stop** or **stop-only** accounting modes. The **stop-only** mode sends only stop records, whereas **start-stop** sends both start and stop records, effectively doubling the number of accounting records. In most cases, **stop-only** is entirely adequate for administrative accounting, because a stop record contains all the information you might need about a session.

In the **set accounting** command, you must include AAA methods that specify whether to use the local database or RADIUS server to receive the accounting records. Specify **local**, which causes the processing to be done on the WX switch, or specify a RADIUS server group. For information about configuring a RADIUS server group, see "Configuring RADIUS Server Groups" on page 524.

For example, you can set accounting for administrative users using the start-stop mode via the local database:

```
WX1200# set accounting admin EXAMPLE\* start-stop local
success: change accepted.
```

The accounting records show the date and time of activity, the user's status and name, and other attributes. The **display accounting statistics** command displays accounting records for administrative users after they have logged in to the WX switch.

(For information about network user accounting, see "Configuring Accounting for Wireless Network Users" on page 504. For information and an output example for the **display accounting statistics** command, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying the AAA Configuration

To display your AAA configuration, type the following command:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=0 key=(null) author-pass=(null)
Radius Servers
Server                  Addr           Ports   T/o Tries Dead State
-------------------------------------------------------------------
r1                   192.168.253.1   1812 1813  5    3    0    UP
Server groups
    sg1: r1
set authentication console * local
set authentication admin * local
set accounting admin Geetha stop-only local
set accounting admin * start-stop local
user Geetha
Password = 1214253d1d19 (encrypted)
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Saving the Configuration

You must save the configuration for all commands that you enter and want to use for future sessions. After you enter the administrator's AAA configuration, type the following command to maintain these commands in WX nonvolatile memory:

```
WX1200# save config
success: configuration saved.
```

You can also specify a filename for the configuration—for example, *configday*. To do this, type the following command:

```
WX1200# save config configday
Configuration saved to configday.
```

You must type the **save config** command to save all configuration changes since the last time you rebooted the WX switch or saved the configuration. If the WX switch is rebooted before you have saved the configuration, all changes are lost.

You can also type the **load config** command, which reloads the WX switch to the last saved configuration or loads a particular configuration filename. (For more information, see "Managing Configuration Files" on page 609.)

Administrative AAA Configuration Scenarios

The following scenarios illustrate typical configurations for administrative and local authentication. For all scenarios, the administrator is Natasha with the password *m@Jor*. (For RADIUS server configuration details, see Chapter 22, "Configuring Communication with RADIUS," on page 519.)

- "Local Authentication" on page 62
- "Local Authentication for Console Users and RADIUS Authentication for Telnet Users" on page 62
- "Local Override and Backup Local Authentication" on page 64
- "Authentication When RADIUS Servers Do Not Respond" on page 63

Local Authentication

The first time you access a WX switch, it requires no authentication. (For more information, see "First-Time Configuration via the Console" on page 55.) In this scenario, after the initial configuration of the WX switch, Natasha is connected through the console and has enabled access.

To enable local authentication for a console user, you must configure a local username. Natasha types the following commands in this order:

```
WX1200# set user natasha password m@Jor
User natasha created
WX1200# set authentication console * local
success: change accepted.
WX1200# save config
success: configuration saved.
```

Local Authentication for Console Users and RADIUS Authentication for Telnet Users

This scenario illustrates how to enable local authentication for console users and RADIUS authentication for Telnet administrative users. To do so, you configure at least one local username for console authentication and set up a RADIUS server for Telnet administrators. Natasha types the following commands in this order:

```
WX1200# set user natasha password m@Jor
User natasha created
WX1200# set authentication console * local
success: change accepted.
WX1200# set radius server r1 address 192.168.253.1 key sunFLOW#$
success: change accepted.
```

Natasha also adds the RADIUS server (*r1*) to the RADIUS server group *sg1*, and configures Telnet administrative users for authentication through the group. She types the following commands in this order:

```
WX1200# set server group sg1 members r1
success: change accepted.
WX1200# set user admin attr service-type 6
success: change accepted.
WX1200# set authentication admin * sg1
success: change accepted.
WX1200# save config
success: configuration saved.
```

If the service-type is not set to 6 (Administrative), the user will not be able to enter "enable" mode commands.

Authentication When RADIUS Servers Do Not Respond

This scenario illustrates how to enable RADIUS authentication for both console and administrative users, but to unconditionally allow access for administrative and console users if the RADIUS server (in this case, server *r1* in server group *sg1*) does not respond. To configure unconditional authentication, Natasha sets the authentication method to **none**. She types the following commands in this order:

```
WX1200# set user natasha password m@Jor
User natasha created
WX1200# set radius server r1 address 192.168.253.1 key
sunFLOW#$
success: change accepted.
WX1200# set server group sg1 members r1
success: change accepted.
WX1200# set authentication console * sg1 none
success: change accepted.
WX1200# set user admin attr service-type 6
success: change accepted.
WX1200# set authentication admin * sg1 none
success: change accepted.
WX1200# save config
success: configuration saved.
```

Local Override and Backup Local Authentication

This scenario illustrates how to enable local override authentication for console users. Local override means that MSS attempts authentication first via the local database. If it finds no match for the user in the local database, MSS then tries a RADIUS server—in this case, server *r1* in server group *sg1*. Natasha types the following commands in this order:

```
WX1200# set user natasha password m@Jor
User natasha created
WX1200# set radius server r1 address 192.168.253.1 key sunFLOW#$
success: change accepted.
WX1200# set server group sg1 members r1
success: change accepted.
WX1200# set authentication console * local sg1
success: change accepted.
WX1200# save config
success: configuration saved.
```

Natasha also enables backup RADIUS authentication for Telnet administrative users. If the RADIUS server does not respond, the user is authenticated by the local database in the WX switch. Natasha types the following commands:

```
WX1200# set authentication admin * sg1 local
success: change accepted.
WX1200# save config
success: configuration saved.
```

The order in which Natasha enters authentication methods in the **set authentication** command determines the method MSS attempts first. The local database is the first method attempted for console users and the last method attempted for Telnet administrators.

4

MANAGING USER PASSWORDS

This chapter describes how to manage user passwords, configure user passwords, and how to display password information.

Overview

3COM recommends that all users create passwords that are memorable to themselves, difficult for others to guess, and not subject to a dictionary attack.

By default, user passwords are automatically encrypted when entered in the local database. However, the encryption is not strong. It is designed only to discourage someone looking over your shoulder from memorizing your password as you display the configuration. To maintain security, MSS displays only the encrypted form of the password in **display** commands.

Optionally, you can configure MSS so that the following additional restrictions apply to user passwords:

- Passwords must be a minimum of 10 characters in length, and a mix of uppercase letters, lowercase letters, numbers, and special characters, including at least two of each (for example, *Tre%Pag32!*).
- A user cannot reuse any of his or her 10 previous passwords (not applicable to network users).
- When a user changes his or her password, at least 4 characters must be different from the previous password.
- A user password expires after a configurable amount of time.

- A user is locked out of the system after a configurable number of failed login attempts. When this happens, a trap is generated and an alert is logged.
- (Administrative users can gain access to the system through the console even when the account is locked.)

- Only one unsuccessful login attempt is allowed in a 10-second period for a user or session.
- All administrative logins, logouts, logouts due to idle timeout, and disconnects are logged.
- The audit log file on the WX switch (*command_audit.cur*) cannot be deleted, and attempts to delete log files are recorded.

These restrictions are disabled by default.

Configuring Passwords

This section describes the following tasks:

- Setting a password for a user in the local database
- Enabling restrictions on password usage
- Setting the maximum number of failed login attempts for a user
- Specifying the minimum allowable password length
- Setting the length of time before password expiration
- Restoring access to a user that has been locked out of the system

Setting Passwords for Local Users

To configure a user's password in the local database, type the following command:

```
set user username password [encrypted] password
```

For example, to configure user Jose with the password *spRin9* in the local database on the WX, type the following command:

```
WX# set user Jose password spRin9
success: User Jose created
```

The **encrypted** option indicates that the password string you are entering is the encrypted form of the password. Use this option only if you do not want MSS to encrypt the password for you.

By default, usernames and passwords in the local database are not case-sensitive; passwords can be made case-sensitive by activating password restrictions, as described in the following section.

To clear a user from the local database, type the following command:

```
clear user username
```

Enabling Password Restrictions

To activate password restrictions for network and administrative users, use the following command:

```
set authentication password-restrict {enable | disable}
```

When this command is enabled, the following password restrictions take effect:

- Passwords must be a minimum of 10 characters in length, and a mix of uppercase letters, lowercase letters, numbers, and special characters, including at least two of each (for example, *Tre%Pag32!*).
- A user cannot reuse any of his or her 10 previous passwords (not applicable to network users).
- When a user changes his or her password, at least 4 characters must be different from the previous password.
- The password restrictions are disabled by default. When you enable them, MSS evaluates the passwords configured on the WX and displays a list of users whose password does not meet the restriction on length and character types.

For example, to enable password restrictions on the WX switch, type the following command:

```
WX# set authentication password-restrict enable
warning: the following users have passwords that do not have
at least 2 each of upper-case letters, lower-case letters,
numbers and special characters -
dan
admin
user1
user2
goofball
dang
success: change accepted.
```

Setting the Maximum Number of Login Attempts

To specify the maximum number of login attempts users can make before being locked out of the system, use the following command:

```
set authentication max-attempts number
```

For Telnet or SSH sessions, a maximum of 4 failed login attempts are allowed by default. For console or network sessions, an unlimited number of failed login attempts are allowed by default.

You can specify a number between 0 – 2147483647. Specifying 0 causes the number of allowable login attempts to reset to the default values.

If a user is locked out of the system, you can restore the user's access with the **clear user lockout** command. (See "Restoring Access to a Locked-Out User" on page 70.)

For example, to allow users a maximum of 3 attempts to log into the system, type the following command:

```
WX# set authentication max-attempts 3
success: change accepted.
```

Specifying Minimum Password Length

To specify the minimum allowable length for user passwords, use the following command:

```
set authentication minimum-password-length length
```

You can specify a minimum password length between 0 ñ 32 characters. Specifying 0 removes the restriction on password length. By default, there is no minimum length for user passwords. When this command is configured, you cannot configure a password shorter than the specified length.

When you enable this command, MSS evaluates the passwords configured on the WX switch and displays a list of users whose password does not meet the minimum length restriction.

For example, to set the minimum length for user passwords at 7 characters, type the following command:

```
WX# set authentication minimum-password-length 7
warning: the following users have passwords that are shorter
than the minimum password length -
dan
admin
user2
goofball
success: change accepted.
```

Configuring Password Expiration Time

To specify how long a user's password is valid before it must be reset, use the following command:

```
set user username expire-password-in time
```

To specify how long the passwords are valid for users in a user group, use the following command:

```
set usergroup group-name expire-password-in time
```

By default, user passwords do not expire. You can use this command to specify how long a specified user's password is valid. After this amount of time, the user's password expires, and a new password will have to be set. The amount of time can be specified in days (for example, *30* or *30d*), hours (720h), or a combination of days and hours (*30d12h*)

For example, the following command sets user Student1ís password to be valid for 30 days:

```
WX# set user Student1 expire-password-in 30
success: change accepted.
```

The following command sets user Student1ís password to be valid for 30 days and 15 hours:

```
WX# set user Student1 expire-password-in 30d15h
success: change accepted.
```

The following command sets user Student1's password to be valid for 720 hours:

```
WX# set user Student1 expire-password-in 720h
success: change accepted.
```

The following command sets the passwords for the users in user group *cardiology* to be valid for 30 days:

```
WX# set usergroup cardiology expire-password-in 30
success: change accepted.
```

Restoring Access to a Locked-Out User

If a user's password has expired, or the user is unable to log in within the configured limit for login attempts, then the user is locked out of the system, and cannot gain access without the intervention of an administrator.

To restore access to a user who had been locked out of the system, use the following command:

```
clear user username lockout
```

If a user has been locked out of the system because of an expired password, you must first assign the user a new password before you can restore access to the user.

The following command restores access to user Nin, who had previously been locked out of the system:

```
WX# clear user Nin lockout
success: change accepted.
```

Displaying Password Information

User password information can be displayed with the **display aaa** command. For example:

```
WX# display aaa
...
...
set authentication password-restrict enable
set authentication minimum-password-length 10
...
user bob
Password = 00121a08015e1f (encrypted)
Password-expires-in = 59 hours (2 days 11 hours)
status = disabled
         vlan-name = default
service-type = 7
```

(For details on displaying passwords, see the *Wireless LAN Switch and Controller Command Reference*.

5

CONFIGURING AND MANAGING PORTS AND VLANS

This chapter describes how to configure and manage ports and VLANs.

Configuring and Managing Ports

You can configure and display information for the following port parameters:

- Port type
- Name
- Speed and autonegotiation
- Port state
- Power over Ethernet (PoE) state
- Load sharing

Setting the Port Type

A WX switch port can be one of the following types:

- Network port. A network port is a Layer 2 switch port that connects the WX switch to other networking devices such as switches and routers.
- MAP access port. A MAP access port connects the WX switch to a MAP. The port also can provide power to the MAP. Wireless users are authenticated to the network through a MAP access port.

A Distributed MAP, which is connected to WX *switches through intermediate Layer 2 or Layer 3 networks, does not use a MAP access port. To configure for a Distributed MAP, see “Configuring a MAP Connection” on page 74 and Chapter 10, “Configuring MAP Access Points,” on page 177.*

- Wired authentication port. A wired authentication port connects the WX switch to user devices, such as workstations, that must be authenticated to access the network.

All WX switch ports are network ports by default. You must set the port type for ports directly connected to MAP access ports and to wired user stations that must be authenticated to access the network. When you change port type, MSS applies default settings appropriate for the port type. Table 5 lists the default settings applied for each port type. For example, the MAP column lists default settings that MSS applies when you change a port type to **ap** (MAP).

Table 5 Port Defaults Set by Port Type Change

	Port Type		
Parameter	**MAP Access**	**Wired Authentication**	**Network**
VLAN membership	Removed from all VLANs. You cannot assign a MAP access port to a VLAN. MSS automatically assigns MAP access ports to VLANs based on user traffic.	Removed from all VLANs. You cannot assign a wired authentication port to a VLAN. MSS automatically assigns wired authentication ports to VLANs based on user traffic.	None **Note:** If you clear a port, MSS resets the port as a network port but does not add the port back to any VLANs. You must explicitly add the port to the desired VLAN(s).
Spanning Tree Protocol (STP)	Not applicable	Not applicable	Based on the STP states of the VLANs the port is in.
802.1X	Uses authentication parameters configured for users.	Uses authentication parameters configured for users.	No authentication.
Port groups	Not applicable	Not applicable	None
IGMP snooping	Enabled as users are authenticated and join VLANs.	Enabled as users are authenticated and join VLANs.	Enabled as the port is added to VLANs.
Maximum user sessions	Not applicable	1 (one)	Not applicable

Table 6 lists how many MAPs you can configure on a WX switch, and how many MAPs a switch can boot. The numbers are for directly connected and Distributed MAPs combined.

Table 6 Maximum MAPs Supported Per Switch

WX Switch Model	Maximum Configured	Maximum Booted
WX4400	300	24, 48, 72, 96, or 120, depending on the license.
WX2200	320	24, 48, 72, 96, or 120, depending on the license.
WX1200	30	12
WXR100	8	3

Setting a Port for a Directly Connected MAP

Before configuring a port as a MAP access port, you must use the ***set system countrycode*** *command to set the IEEE 802.11 country-specific regulations on the WX switch. (See "Specifying the Country of Operation" on page 213.)*

Some MSS features that work with directly connected MAPs require a port number to be specified. For this purpose, you can optionally specify the port number attached to a directly connected MAP.

To set a port for a MAP, use the following command:

```
set port type ap port-list
model {2330 | 2330A | AP2750 | AP3150 | AP3750 | mp-52 |
mp-241 | mp-252 | mp-262 | mp-341 | mp-352 | mp-372 |
mp-372-CN | mp-372-JP | mp422 | mp620} poe {enable | disable}
[radiotype {11a | 11b | 11g}]
```

You must specify a port list of one or more port numbers, the MAP model number, and the PoE state. (For details about port lists, see "Port Lists" on page 32.)

MAP models AP2750, MP-241, and MP-341 have a single radio that can be configured for 802.11b/g. Other MAP models have two radios. On two-radio models, one radio is always 802.11a. The other radio is 802.11b/g, but can be configured for 802.11b or 802.11g exclusively. If the country of operation specified by the **set system countrycode** command does not allow 802.11g, the default is 802.11b.

Models MP-52, MP-241, MP-252, MP-262, MP-341, and MP-352 have been discontinued but are still supported by the command.

You cannot configure any gigabit Ethernet port, or port 7 or 8 on a WX1200 switch, or port 1 on a WXR100, as a MAP port. To manage a MAP on a switch model that does not have 10/100 Ethernet ports, configure a Distributed MAP connection on the switch. (See "Configuring a MAP Connection" on page 74.)

The radio models in MP-620 require external antenna, and model MP-262 requires an external antenna for the 802.11b/g radio. The following models have internal antennas but also have connectors for optional use of external antennas instead: AP2750, AP3150, AP3750, AP7250, AP8250, AP8750, MP-372, MP-372-CN, and MP-372-JP. (Antenna support on a specific model is limited to the antennas certified for use with that model.) To specify the antenna model, use the **set {ap | dap} radio antennatype** command.

To set ports 4 through 6 for MAP model AP2750 and enable PoE on the ports, type the following command:

```
WX1200# set ap <apnum> port <port> model <ap_type> [ poe
<enable | disable> ]
This may affect the power applied on the configured ports.
Would you like to continue? (y/n) [n]y
success: change accepted.
```

Additional configuration is required to place a MAP into operation. For information, see Chapter 10, "Configuring MAP Access Points," on page 177.

Configuring a MAP Connection

To configure a connection for a MAP (referred to as a *AP* in the CLI), use the following command:

```
set ap apnumber serial-id serial-ID
model {2230 | 2230A | AP7250 | AP3150 | AP3750 | mp-52 |
mp-241 | mp-252 | mp-262 | mp-341 | mp-352 | mp-372 |
mp-372-CN | mp-422 | mp620} [radiotype {11a | 11b| 11g}]
```

The *apnumber* refers to an index value that identifies the MAP on the WX switch. This value does not have to be related to the port to which the MAP is connected.

The range of valid *apnumber* values depends on the WX model. Table 7 lists the ranges for each WX model.

Table 7 Valid dap-num Values

Switch Model	Valid Range
WX4400	1 to 300
WX1200	1 to 30
WXR100	1 to 8
WX2200	1 to 320

For the **serial-id** parameter, specify the serial ID of the MAP. The serial ID is listed on the MAP case. To display the serial ID using the CLI, use the **display version details** command.

The **model** and **radiotype** parameters have the same options as they do with the **set port type ap** command. Because the WX does not supply power to an indirectly connected MAP, the **set ap** command does not use the **poe** parameter.

To configure a connection for MAP 1, which is a MAP model MP-372 with serial-ID 0322199999, type the following command:

```
WX# set ap 1 serial-id 0322199999 model mp-372
success: change accepted.
```

Setting a Port for a Wired Authentication User

To set a port for a wired authentication user, use the following command:

```
set port type wired-auth port-list [tag tag-list]
[max-sessions num]
```

You must specify a port list. Optionally, you also can specify a tag-list to subdivide the port into virtual ports, and set the maximum number of simultaneous user sessions that can be active on the port. By default, one user session can be active on the port at a time.

The *fallthru* authentication type is used if the user does not support 802.1X and is not authenticated by MAC authentication. The default is none, which means the user is automatically denied access if neither 802.1X authentication or MAC authentication is successful.

To set port 17 as a wired authentication port, type the following command:

```
WX1200# set port type wired-auth 7
success: change accepted
```

This command configures port 7 as a wired authentication port supporting one interface and one simultaneous user session.

For 802.1X clients, wired authentication works only if the clients are directly attached to the wired authentication port, or are attached through a hub that does not block forwarding of packets from the client to the PAE group address (01:80:c2:00:00:03). Wired authentication works in accordance with the 802.1X specification, which prohibits a client from sending traffic directly to an authenticator's MAC address until the client is authenticated. Instead of sending traffic to the authenticator's MAC address, the client sends packets to the PAE group address. The 802.1X specification prohibits networking devices from forwarding PAE group address packets, because this would make it possible for multiple authenticators to acquire the same client.

For non-802.1X clients, who use MAC authentication, WebAAA, or last-resort authentication, wired authentication works if the clients are directly attached or indirectly attached.

If clients are connected to a wired authentication port through a downstream third-party switch, the WX switch attempts to authenticate based on any traffic coming from the switch, such as Spanning Tree Protocol (STP) BPDUs. In this case, disable repetitive traffic emissions such as STP BPDUs from downstream switches. If you want to provide a management path to a downstream switch, use MAC authentication.

Clearing a Port

To change a port's type from MAP access port or wired authentication port, you must first clear the port, then set the port type.

***CAUTION:** When you clear a port, MSS ends user sessions on the port.*

Clearing a port removes all the port's configuration settings and resets the port as a network port.

- If the port is a MAP access port, clearing the port disables PoE and 802.1X authentication.
- If the port is a wired authenticated port, clearing the port disables 802.1X authentication.
- If the port is a network port, the port must first be removed from all VLANs, which removes the port from all spanning trees, load-sharing port groups, and so on.

A cleared port is not placed in any VLANs, not even the default VLAN (VLAN 1).

To clear a port, use the following command:

```
clear port type port-list
```

For example, to clear the port-related settings from port 5 and reset the port as a network port, type the following command:

```
WX1200# clear port type 5
This may disrupt currently authenticated users. Are you sure?
(y/n) [n]y
success: change accepted.
```

Clearing a Distributed MAP

To clear a Distributed MAP, use the following command:

```
clear ap apnumber
```

Configuring a Port Name

Each WX switch port has a number but does not have a name by default.

Setting a Port Name

To set a port name, use the following command:

```
set port port name name
```

You can specify only a single port number with the command.

To set the name of port 2 to *adminpool*, type the following command:

```
WX1200# set port 2 name adminpool
success: change accepted.
```

To avoid confusion, 3Com recommends that you do not use numbers as port names.

Removing a Port Name

To remove a port name, use the following command:

```
clear port port-list name
```

Configuring Interface Preference on a Dual-Interface Gigabit Ethernet Port (WX4400 only)

The gigabit Ethernet ports on a WX4400 have two physical interfaces: a 1000BASE-TX copper interface and a 1000BASE-SX or 1000BASE-LX fiber interface. The copper interface is provided by a built-in RJ-45 connector. The fiber interface is optional and requires insertion of a Gigabit interface converter (GBIC).

Only one interface can be active on a port. By default, MSS prefers the GBIC (fiber) interface. You can configure a port to prefer the RJ-45 (copper) interface instead.

If you set the preference to RJ-45 on a port that already has an active fiber link, MSS immediately changes the link to the copper interface.

To disable the fiber interface and enable the copper interface on a WX4400 port, use the following command:

```
set port media-type port-list rj45
```

To disable the copper interface and reenable the fiber interface on a WX4400 port, use the following command:

```
clear port media-type port-list
```

To display the enabled interface type for each port, use the following command:

```
display port media-type [port-list]
```

To disable the fiber interface and enable the copper interface of port 2 on a WX4400 switch and verify the change, type the following commands:

```
WX4400# set port media-type 2 rj45
WX4400# display port media-type
Port  Media Type
============================================================
   1  GBIC
   2  RJ45
   3  GBIC
   4  GBIC
```

Configuring Port Operating Parameters

Autonegotiation is enabled by default on a WX switch's 10/100 Ethernet ports and gigabit Ethernet ports.

You can configure the following port operating parameters:

- Speed
- Autonegotiation
- Port state
- PoE state

All ports on the WX4400 switches support full-duplex operating mode only. They do not support half-duplex operation. Ports on the WX1200 switch support half-duplex and full-duplex operation.

3Com recommends that you do not configure the mode of a WX port so that one side of the link is set to autonegotiation while the other side is set to full-duplex. Although MSS allows this configuration, it can result in slow throughput on the link. The slow throughput occurs because the side that is configured for autonegotiation falls back to half-duplex. A stream of large packets sent to a WX port in such a configuration can cause forwarding on the link to stop.

You also can toggle a port's administrative state and PoE setting off and back on to reset the port.

10/100 Ports—Autonegotiation and Port Speed

WX 10/100 Ethernet ports use autonegotiation by default to determine the appropriate port speed.

To explicitly set the port speed of a 10/100 port, use the following command:

```
set port speed port-list {10 | 100 | auto}
```

If you explicitly set the port speed (by selecting an option other than ***auto****) of a 10/100 Ethernet port, the operating mode is set to full-duplex.*

MSS allows the port speed of a gigabit port to be set to auto. However, this setting is invalid. If you set the port speed of a gigabit port to auto, the link will stop working.

To set the port speed on ports 1 and 3 through 5 to 10 Mbps, type the following command:

```
WX1200# set port speed 1,3-5 10
```

Gigabit Ports — Autonegotiation and Flow Control

WX gigabit ports use autonegotiation by default to determine capabilities for 802.3z flow control parameters. The gigabit ports can respond to IEEE 802.3z flow control packets. Some devices use this capability to prevent packet loss by temporarily pausing data transmission.

To disable flow control negotiation on a WX gigabit port, use the following command:

```
set port negotiation port-list {enable | disable}
```

Disabling or Reenabling a Port

All ports are enabled by default. To administratively disable a port, use the following command:

```
set port {enable | disable} port-list
```

A port that is administratively disabled cannot send or receive packets. This command does not affect the link state of the port.

Disabling or Reenabling Power over Ethernet

Power over Ethernet (PoE) supplies DC power to a device connected to a MAP access port. The PoE state depends on whether you enable or disable PoE when you set the port type. (See “Setting the Port Type” on page 71.)

CAUTION: *Use the WX switch's PoE only to power 3Com MAPs. If you enable PoE on ports connected to other devices, damage can result.*

PoE is supported only on 10/100 Ethernet ports. PoE is not supported on any gigabit Ethernet ports, or on ports 7 and 8 on a WX1200 switch.

To change the PoE state on a port, use the following command:

```
set ap <apnum> port <portnumb> model <ap_type> poe {enable |
disable}
```

Resetting a Port

You can reset a port by toggling its link state and PoE state. MSS disables the port's link and PoE (if applicable) for at least one second, then reenables them. This feature is useful for forcing a MAP that is connected to two WX switches to reboot using the port connected to the other switch.

To reset a port, use the following command:

`reset port` *`port-list`*

Displaying Port Information

You can use CLI commands to display the following port information:

- Port configuration and status
- PoE state
- Port statistics

You also can configure MSS to display and regularly update port statistics in a separate window.

Displaying Port Configuration and Status

To display port configuration and status information, use the following command:

`display port status` `[`*`port-list`*`]`

To display information for all ports, type the following command:

```
WX1200# display port status
Port  Name            Admin  Oper   Config    Actual   Type       Media
===============================================================================
   1  1               up     up      auto     100/full  network    10/100BaseTx
   2  2               up     down    auto               network    10/100BaseTx
   3  3               up     down    auto               network    10/100BaseTx
   4  4               up     down    auto               network    10/100BaseTx
   5  5               up     up      auto     100/full  ap         10/100BaseTx
   6  6               up     up      auto     100/full  network    10/100BaseTx
   7  7               up     down    auto               network    10/100BaseTx
   8  8               up     down    auto               network    10/100BaseTx
```

In this example, three of the switch's ports, 1, 5, and 6, have an operational status of *up*, indicating the links on the ports are available. Ports 1 and 6 are network ports. Port 5 is a MAP access port.

(For more information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying PoE State

To display the PoE state of a port, use the following command:

```
display port poe [port-list]
```

To display PoE information for ports 1 and 3, type the following command:

```
WX1200# display port poe 1,3
                     Link     Port   PoE        PoE
Port  Name           Status   Type   config     Draw
===================================================
   1 1               down     MAP    disabled   off
   3 3               up       MAP    enabled    1.44
```

In this example, PoE is disabled on port 1 and enabled on port 3. The MAP connected to port 3 is drawing 1.44 W of power from the WX switch.

(For more information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Port Statistics

To display port statistics, use the following command:

```
display port counters [octets | packets | receive-errors |
transmit-errors | collisions | receive-etherstats |
transmit-etherstats] [port port-list]
```

You can specify one statistic type with the command. For example, to display octet statistics for port 3, type the following command:

```
WX1200# display port counters octets port 3
Port   Status                      Rx Octets                       Tx Octets
===============================================================================
    3  Up                          27965420                        34886544
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

To display all types of statistics with the same command, use the ***monitor port counters*** *command. (See "Monitoring Port Statistics" on page 83.)*

Clearing Statistics Counters

To clear all port statistics counters, use the following command:

```
clear port counters
```

The counters begin incrementing again, starting from 0.

Monitoring Port Statistics

You can display port statistics in a format that continually updates the counters. When you enable monitoring of port statistics, MSS clears the CLI session window and displays the statistics at the top of the window. MSS refreshes the statistics every 5 seconds. This interval cannot be configured.

To monitor port statistics, use the following command:

```
monitor port counters [octets | packets | receive-errors |
transmit-errors | collisions | receive-etherstats |
transmit-etherstats]
```

Statistics types are displayed in the following order by default:

- Octets
- Packets
- Receive errors
- Transmit errors
- Collisions
- Receive Ethernet statistics
- Transmit Ethernet statistics

Each type of statistic is displayed separately. Press the Spacebar to cycle through the displays for each type.

If you use an option to specify a statistic type, the display begins with that statistic type. You can use one statistic option with the command.

Use the keys listed in Table 8 to control the monitor display.

Table 8 Key Controls for Monitor Port Counters Display

Key	Effect on monitor display
Spacebar	Advances to the next statistics type.
Esc	Exits the monitor. MSS stops displaying the statistics and displays a new command prompt.
c	Clears the statistics counters for the currently displayed statistics type. The counters begin incrementing again.

To monitor port statistics beginning with octet statistics (the default), type the following command:

```
WX1200# monitor port counters
```

As soon as you press Enter, MSS clears the window and displays statistics at the top of the window. In this example, the octet statistics are displayed first.

```
Port   Status                        Rx Octets                         Tx Octets
================================================================================
   1   Up                            27965420                          34886544
...
```

To cycle the display to the next set of statistics, press the Spacebar. In this example, packet statistics are displayed next:

```
Port   Status     Rx Unicast    Rx NonUnicast       Tx Unicast      Tx NonUnicast
================================================================================
   1   Up            54620            62144            68318              62556
...
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Configuring Load-Sharing Port Groups

A port group is a set of physical ports that function together as a single link and provide load sharing and link redundancy. Only network ports can participate in a port group.

You can configure up to 8 ports in a port group, in any combination of ports. The port numbers do not need to be contiguous and you can use 10/100 Ethernet ports and gigabit Ethernet ports in the same port group.

Load Sharing

A WX switch balances the port group traffic among the group's physical ports by assigning traffic flows to ports based on the traffic's source and destination MAC addresses. The switch assigns a traffic flow to an individual port and uses the same port for all subsequent traffic for that flow.

Link Redundancy

A port group ensures link stability by providing redundant connections for the same link. If an individual port in a group fails, the WX switch reassigns traffic to the remaining ports. When the failed port starts operating again, the WX switch begins using it for new traffic flows. Traffic that belonged to the port before it failed continues to be assigned to other ports.

Configuring a Port Group

To configure a port group, use the following command:

```
set port-group name group-name port-list mode {on | off}
```

Enter a name for the group and the ports contained in the group.

Do not use dashes or hyphens in a port group name. MSS will not display or save the port group. The port group name must start with a letter.

The **mode** parameter adds or removes ports for a group that is already configured. To modify a group:

- **Adding ports** — Enter the ports you want to add, then enter **mode on**.
- **Removing ports** — Enter the ports you want to remove, then enter **mode off**.

To configure a port group named *server1* containing ports 1 through 5 and enable the link, type the following command:

```
WX1200# set port-group name server1 1-5 mode on
success: change accepted.
```

After you configure a port group, you can use the port group name with commands that change Layer 2 configuration parameters to apply configuration changes to all ports in the port group. For example, Spanning Tree Protocol (STP) and VLAN membership changes affect the entire port group instead of individual ports. When you make Layer 2 configuration changes, you can use a port group name in place of the port list. Ethernet port statistics continue to apply to individual ports, not to port groups.

To configure a port group named *server2* containing ports 2 and 5 and add the ports to the *default* VLAN, type the following commands:

```
WX1200# set port-group name server2 2,5 mode on
success: change accepted.
WX1200# set vlan default port server2
success: change accepted.
```

To verify the configuration change, type the following command:

```
WX1200# display vlan config
                      Admin  VLAN  Tunl                        Port
VLAN Name             Status State Affin Port             Tag   State
---- ---------------- ------ ----- ----- ---------------- ----- -----
   1 default          Up     Up        5
                                         server2          none  Up
4094 web-aaa          Up     Up        0
                                         2                 4094 Up
```

The web-aaa VLAN is used by the WebAAA feature and is automatically configured by MSS.

To indicate that the ports are configured as a port group, the **display vlan config** output lists the port group name instead of the individual port numbers.

Removing a Port Group

To remove a port group, use the following command:

```
clear port-group name name
```

Displaying Port Group Information

To display port group information, use the following command:

```
display port-group [name group-name]
```

To display the configuration and status of port group *server2*, type the following command:

```
WX1200# display port-group name server2
Port group: server2 is up
        Ports:  2, 5
```

Interoperating with Cisco Systems EtherChannel

Load-sharing port groups are interoperable with Cisco Systems EtherChannel capabilities. To configure a Cisco Catalyst switch to interoperate with a 3Com WX switch, use the following command on the Catalyst switch:

```
set port channel port-list mode on
```

Configuring and Managing VLANs

The CLI commands in this chapter configure VLANs on WX switch network ports. The commands do not configure VLAN membership for wireless or wired authentication users. To assign a user to a VLAN, configure the RADIUS Tunnel-Private-Group-ID attribute or the VLAN-Name vendor specific attribute (VSA) for that user. (For more information, see Chapter 21, “Configuring AAA for Network Users,” on page 433.)

Understanding VLANs in 3Com MSS

A virtual LAN (VLAN) is a Layer 2 broadcast domain that can span multiple wired or wireless LAN segments. Each VLAN is a separate logical network and, if you configure IP interfaces on the VLANs, MSS treats each VLAN as a separate IP subnet.

Only network ports can be preconfigured to be members of one or more VLAN(s). You configure VLANs on a WX switch’s network ports by configuring them on the switch itself. You configure a VLAN by assigning a name and network ports to the VLAN. Optionally, you can assign VLAN tag values on individual network ports. You can configure multiple VLANs on a WX switch’s network ports. Optionally, each VLAN can have an IP address.

VLANs are not configured on MAP access ports or wired authentication ports, because the VLAN membership of these types of ports is determined dynamically through the authentication and authorization process. Users who require authentication connect through WX switch ports that are configured for MAPs or wired authentication access. Users are assigned to VLANs automatically through authentication and authorization mechanisms such as 802.1X.

By default, none of a WX switch's ports are in VLANs. A switch cannot forward traffic on the network until you configure VLANs and add network ports to those VLANs.

A wireless client cannot join a VLAN if the physical network ports on the WX *switch in the VLAN are down. However, a wireless client that is already in a VLAN whose physical network ports go down remains in the VLAN even though the VLAN is down.*

VLANs, IP Subnets, and IP Addressing

Generally, VLANs are equivalent to IP subnets. If a WX switch is connected to the network by only one IP subnet, the switch must have at least one VLAN configured. Optionally, each VLAN can have its own IP address. However, no two IP addresses on the switch can belong to the same IP subnet.

You must assign the system IP address to one of the VLANs, for communications between WX switches and for unsolicited communications such as SNMP traps and RADIUS accounting messages. Any IP address configured on a WX switch can be used for management access unless explicitly restricted. (For more information about the system IP address, see Chapter 6, "Configuring and Managing IP Interfaces and Services," on page 103.)

Users and VLANs

When a user successfully authenticates to the network, the user is assigned to a specific VLAN. A user remains associated with the same VLAN throughout the user's session on the network, even when roaming from one WX switch to another within the Mobility Domain.

You assign a user to a VLAN by setting one of the following attributes on the RADIUS servers or in the local user database:

- **Tunnel-Private-Group-ID** — This attribute is described in RFC 2868, *RADIUS Attributes for Tunnel Protocol Support*.
- **VLAN-Name** — This attribute is a 3Com vendor-specific attribute (VSA).

You cannot configure the Tunnel-Private-Group-ID attribute in the local user database.

Specify the VLAN name, not the VLAN number. The examples in this chapter assume the VLAN is assigned on a RADIUS server with either of the valid attributes. (For more information, see Chapter 21, "Configuring AAA for Network Users," on page 433.)

VLAN Names

To create a VLAN, you must assign a name to it. VLAN names must be globally unique across a Mobility Domain to ensure the intended user connectivity as determined through authentication and authorization.

Every VLAN on a WX switch has both a VLAN name, used for authorization purposes, and a VLAN number. VLAN numbers can vary uniquely for each WX switch and are not related to 802.1Q tag values.

You cannot use a number as the first character in a VLAN name.

Roaming and VLANs

WX switches in a Mobility Domain contain a user's traffic within the VLAN that the user is assigned to. For example, if you assign a user to VLAN *red*, the WX switches in the Mobility Domain contain the user's traffic within VLAN *red* configured on the switches.

The WX switch through which a user is authenticated is not required to be a member of the VLAN the user is assigned to. You are not required to configure the VLAN on all WX switches in the Mobility Domain. When a user roams to a switch that is not a member of the VLAN the user is assigned to, the switch can tunnel traffic for the user through another switch that is a member of the VLAN. The traffic can be of any protocol type. (For more information about Mobility Domains, see Chapter 8, "Configuring and Managing Mobility Domain Roaming," on page 153.)

Because the default VLAN (VLAN 1) might not be in the same subnet on each switch, 3Com recommends that you do not rename the default VLAN or use it for user traffic. Instead, configure other VLANs for user traffic.

Traffic Forwarding

A WX switch switches traffic at Layer 2 among ports in the same VLAN. For example, suppose you configure ports 4 and 5 to belong to VLAN 2 and ports 6 and 7 to belong to VLAN 3. As a result, traffic between port 4 and port 5 is switched, but traffic between port 4 and port 6 is not switched and needs to be routed by an external router.

802.1Q Tagging

The tagging capabilities of the WX switch are very flexible. You can assign 802.1Q tag values on a per-VLAN, per-port basis. The same VLAN can have different tag values on different ports. In addition, the same tag value can be used by different VLANs but on different network ports.

If you use a tag value, 3Com recommends that you use the same value as the VLAN number. MSS does not require the VLAN number and tag value to be the same, but some other devices do.

Do not assign the same VLAN multiple times using different tag values to the same network port. Although MSS does not prohibit you from doing so, the configuration is not supported.

MSS automatically assigns tag values to Distributed MAPs. Each of these tag values represents a unique combination of radio, encryption type, and VLAN. These tag values do not necessarily correspond to tag values you configure on the VLAN ports through which the Distributed MAP is connected to the WX.

Tunnel Affinity

WX switches configured as a Mobility Domain allow users to roam seamlessly across MAPs and even across WX switches. Although a switch that is not a member of a user’s VLAN cannot directly forward traffic for the user, the switch can tunnel the traffic to another WX switch that is a member of the user’s VLAN.

If the WX switch that is not in the user's VLAN has a choice of more than one other WX switch through which to tunnel the user's traffic, the switch selects the other switch based on an affinity value. This is a numeric value that each WX switch within a Mobility Domain advertises, for each of its VLANs, to all other switches in the Mobility Domain. A switch outside the user's VLAN selects the other operational switch that has the highest affinity value for the user's VLAN to forward traffic for the user.

If more than one WX switch has the highest affinity value, MSS randomly selects one of the switches for the tunnel.

Configuring a VLAN

You can configure the following VLAN parameters:

- VLAN number
- VLAN name
- Port list (the ports in the VLAN)
- Per-port tag value (an 802.1Q value representing a virtual port in the VLAN)
- Tunnel affinity (a value that influences tunneling connections for roaming)
- MAC restriction list (if you want to prevent clients from communicating with one another directly at Layer 2)

Creating a VLAN

To create a VLAN, use the following command:

```
set vlan vlan-num name name
```

Specify a VLAN number from 2 to 4093, and specify a name up to 16 alphabetic characters long.

You cannot use a number as the first character in a VLAN name. 3Com recommends that you do not use the same name with different capitalizations for VLANs or ACLs. For example, do not configure two separate VLANs with the names *red* and *RED*.

3Com recommends that you do not use the name default. *This name is already used for VLAN 1. 3Com also recommends that you do not rename the default VLAN.*

You must assign a name to a VLAN before you can add ports to the VLAN. You can configure the name and add ports with a single **set vlan** command or separate **set vlan** commands.

Once you assign a VLAN number to a VLAN, you cannot change the number. However, you can change a VLAN's name.

For example, to assign the name *red* to VLAN 2, type the following command:

```
WX1200# set vlan 2 name red
```

After you create a VLAN, you can use the VLAN number or the VLAN name in commands. In addition, the VLAN name appears in CLI and 3Com Wireless Switch Manager displays.

Adding Ports to a VLAN

To add a port to a VLAN, use the following command:

```
set vlan vlan-id port port-list [tag tag-value]
```

You can specify a tag value from 1 through 4093.

MSS does not remove a port from other VLANs when you add the port to a new VLAN. If a new VLAN causes a configuration conflict with an older VLAN, remove the port from the older VLAN before adding the port to the new VLAN.

For example, to add ports 3 through 6 and port 8 to VLAN *red*, type the following command:

```
WX1200# set vlan red port 3-6,8
success: change accepted.
```

Optionally, you also can specify a tag value to be used on trunked 802.1Q ports.

To assign the name *marigold* to VLAN 4, add ports 1 through 4 and port 6, and assign tag value 11 to port 6, type the following commands:

```
WX1200# set vlan 4 name marigold port 1-4
success: change accepted.
WX1200# set vlan 4 name marigold port 6 tag 11
success: change accepted.
```

Removing an Entire VLAN or a VLAN Port

To remove an entire VLAN or a specific port and tag value from a VLAN, use the following command:

```
clear vlan vlan-id [port port-list [tag tag-value]]
```

CAUTION: *When you remove a VLAN, MSS completely removes the VLAN from the configuration and also removes all configuration information that uses the VLAN. If you want to remove only a specific port from the VLAN, make sure you specify the port number in the command.*

The **clear vlan** command with a VLAN ID but without a port list or tag value clears all ports and tag values from the VLAN.

To remove port 3 from VLAN *red*, type the following command:

```
WX1200# clear vlan red port 3
This may disrupt user connectivity.
Do you wish to continue? (y/n) [n]y
success: change accepted.
```

To clear port 6, which uses tag value 11, from VLAN *marigold*, type the following command:

```
WX1200# clear vlan marigold port 6 tag 11
This may disrupt user connectivity.
Do you wish to continue? (y/n) [n]y
success: change accepted.
```

To completely remove VLAN *ecru*, type the following command:

```
WX1200# clear vlan ecru
This may disrupt user connectivity.
Do you wish to continue? (y/n) [n]y
success: change accepted.
```

You cannot remove the default VLAN (VLAN 1). However, you can add and remove ports. You can also rename the default VLAN, but 3Com recommends against it.

Changing Tunneling Affinity

To change the tunneling affinity, use the following command:

```
set vlan vlan-id tunnel-affinity num
```

Specify a value from 1 through 10. The default is 5.

Restricting Layer 2 Forwarding Among Clients

By default, clients within a VLAN are able to communicate with one another directly at Layer 2. You can enhance network security by restricting Layer 2 forwarding among clients in the same VLAN. When you restrict Layer 2 forwarding in a VLAN, MSS allows Layer 2 forwarding only between a client and a set of MAC addresses, generally the VLAN's default routers. Clients within the VLAN are not permitted to communicate among themselves directly. To communicate with another client, the client must use one of the specified gateway routers.

For networks with IP-only clients, you can restrict client-to-client forwarding using ACLs. (See "Restricting Client-To-Client Forwarding Among IP-Only Clients" on page 409.)

To restrict Layer 2 forwarding in a VLAN, use the following command:

```
set security l2-restrict vlan vlan-id
[mode {enable | disable}] [permit-mac mac-addr [mac-addr]]
```

You can specify multiple addresses by listing them on the same command line or by entering multiple commands.

Restriction of client traffic does not begin until you enable the permitted MAC list. Use the **mode enable** option with this command.

To change a MAC address, use the **clear security l2-restrict** command to remove it, then use the **set security l2-restrict** command to add the correct address.

```
clear security l2-restrict vlan vlan-id
[permit-mac mac-addr [mac-addr] | all]
```

There can be a slight delay before functions such as pinging between clients become available again after Layer 2 restrictions are lifted. Even though packets are passed immediately once Layer 2 restrictions are gone, it can take 10 seconds or more for upper-layer protocols to update their ARP caches and regain their functionality.

To display configuration information and statistics for Layer 2 forwarding restriction, use the following command:

```
display security l2-restrict [vlan vlan-id | all]
```

The following commands restrict Layer 2 forwarding of client data in VLAN *abc_air* to the default routers with MAC address aa:bb:cc:dd:ee:ff and 11:22:33:44:55:66, and display restriction information and statistics:

```
WX1200# set security l2-restrict vlan abc_air mode enable
permit-mac aa:bb:cc:dd:ee:ff 11:22:33:44:55:66
success: change accepted.
WX1200# display security l2-restrict
VLAN Name          En Drops      Permit MAC          Hits
---- ----------- -- ---------- ------------------- ----------
1 abc_air   Y            0 aa:bb:cc:dd:ee:ff         5947
                        11:22:33:44:55:66            9
```

The En field indicates whether restriction is enabled. The Drops field indicates how many packets were addressed directly from one client to another and dropped by MSS. The Hits field indicates how many packets the permitted default router has received from clients.

To reset the statistics counters, use the following command:

```
clear security l2-restrict counters [vlan vlan-id | all]
```

Displaying VLAN Information

To display VLAN configuration information, use the following command:

```
display vlan config [vlan-id]
```

To display information for VLAN *burgundy*, type the following command:

```
WX1200# display vlan config burgundy
                      Admin  VLAN  Tunl                         Port
VLAN Name             Status State Affin Port             Tag   State
---- ---------------- ------ ----- ----- ---------------- ----- -----
   2 burgundy         Up     Up        5
                                         2                none   Up
                                         3                none   Up
                                         4                none   Up
                                         6                none   Up
4094 web-aaa          Up     Up        0
                                         2                 4094 Up
```

The display can include MAP access ports and wired authentication ports, because MSS dynamically adds these ports to a VLAN when handling user traffic for the VLAN.

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Managing the Layer 2 Forwarding Database

A WX switch uses a Layer 2 forwarding database (FDB) to forward traffic within a VLAN. The entries in the forwarding database map MAC addresses to the physical or virtual ports connected to those MAC addresses within a particular VLAN. To forward a packet to another device in a VLAN, the WX switch searches the forwarding database for the packet's destination MAC address, then forwards the packet out the port associated with the MAC address.

Types of Forwarding Database Entries

The forwarding database can contain the following types of entries:

- **Dynamic** — A dynamic entry is a temporary entry that remains in the database only until the entry is no longer used. By default, a dynamic entry ages out if it remains unused for 300 seconds (5 minutes). All dynamic entries are removed if the WX switch is powered down or rebooted.
- **Static** — A static entry does not age out, regardless of how often the entry is used. However, like dynamic entries, static entries are removed if the WX switch is powered down or rebooted.
- **Permanent** — A permanent entry does not age out, regardless of how often the entry is used. In addition, a permanent entry remains in the forwarding database even following a reboot or power cycle.

How Entries Enter the Forwarding Database

An entry enters the forwarding database in one of the following ways:

- **Learned from traffic received by the WX switch** — When the WX switch receives a packet, the switch adds the packet's source MAC address to the forwarding database if the database does not already contain an entry for that MAC address.
- **Added by the system administrator** — You can add static and permanent unicast entries to the forwarding database. (You cannot add a multicast or broadcast address as a permanent or static forwarding database entry.)
- **Added by the WX switch itself** — For example, the authentication protocols can add entries for wired and wireless authentication users. The WX switch also adds any static entries added by the system administrator and saved in the configuration file.

Displaying Forwarding Database Information

You can display the forwarding database size and the entries contained in the database.

Displaying the Size of the Forwarding Database

To display the number of entries contained in the forwarding database, use the following command:

```
display fdb count {perm | static | dynamic} [vlan vlan-id]
```

For example, to display the number of dynamic entries that the forwarding database contains, type the following command:

```
WX1200# display fdb count dynamic
Total Matching Entries = 2
```

Displaying Forwarding Database Entries

To display the entries in the forwarding database, use either of the following commands:

```
display fdb [mac-addr-glob [vlan vlan-id]]
display fdb  {perm | static | dynamic | system | all}
[port port-list | vlan vlan-id]
```

The *mac-addr-glob* parameter can be an individual address, or a portion of an address with the asterisk (*) wildcard character representing from 1 to 5 bytes. The wildcard allows the parameter to indicate a list of MAC addresses that match all the characters except the asterisk.

Use a colon between each byte in the address (for example, **11:22:33:aa:bb:cc** or **11:22:33:***). You can enter the asterisk (*) at the beginning or end of the address as a wildcard, on any byte boundary.

To display all entries in the forwarding database, type the following command:

```
WX1200# display fdb all
* = Static Entry. + = Permanent Entry. # = System Entry.
VLAN TAG  Dest MAC/Route Des [CoS]  Destination Ports        [Protocol Type]
---- ---- ------------------ -----  -----------------------------------------
   1      00:01:97:13:0b:1f               1                        [ALL]
   1      aa:bb:cc:dd:ee:ff      *        3                        [ALL]
   1      00:0b:0e:02:76:f5               1                        [ALL]
Total Matching FDB Entries Displayed = 3
```

To display all entries that begin with 00, type the following command:

```
WX1200# display fdb 00:*
* = Static Entry. + = Permanent Entry. # = System Entry.
VLAN TAG  Dest MAC/Route Des [CoS]  Destination Ports        [Protocol Type]
---- ---- ------------------ -----  -----------------------------------------
   1      00:01:97:13:0b:1f               1                        [ALL]
   1      00:0b:0e:02:76:f5               1                        [ALL]
Total Matching FDB Entries Displayed = 2
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Adding an Entry to the Forwarding Database

To add an entry to the forwarding database, use the following command:

```
set fdb {perm | static} mac-addr port port-list vlan vlan-id
[tag tag-value]
```

To add a permanent entry for MAC address 00:bb:cc:dd:ee:ff on ports 3 and 5 in VLAN *blue*, type the following command:

```
WX1200# set fdb perm 00:bb:cc:dd:ee:ff port 3,5 vlan blue
success: change accepted.
```

To add a static entry for MAC address 00:2b:3c:4d:5e:6f on port 1 in the *default* VLAN, type the following command:

```
WX1200# set fdb static 00:2b:3c:4d:5e:6f port 1 vlan default
success: change accepted.
```

Removing Entries from the Forwarding Database

To remove an entry from the forwarding database, use the following command:

```
clear fdb {perm | static | dynamic | port port-list}
[vlan vlan-id] [tag tag-value]
```

To clear all dynamic forwarding database entries that match all VLANs, type the following command:

```
WX1200# clear fdb dynamic
success: change accepted.
```

To clear all dynamic forwarding database entries that match ports 3 and 5, type the following command:

```
WX1200# clear fdb port 3,5
success: change accepted.
```

Configuring the Aging Timeout Period

The aging timeout period specifies how long a dynamic entry can remain unused before the software removes the entry from the database.

You can change the aging timeout period on an individual VLAN basis. You can change the timeout period to a value from 0 through 1,000,000 seconds. The default aging timeout period is 300 seconds (5 minutes). If you change the timeout period to 0, aging is disabled.

Displaying the Aging Timeout Period

To display the current setting of the aging timeout period, use the following command:

```
display fdb agingtime [vlan vlan-id]
```

For example, to display the aging timeout period for all configured VLANs, type the following command:

```
WX1200# display fdb agingtime
VLAN 2 aging time = 300 sec
VLAN 1 aging time = 300 sec
```

Changing the Aging Timeout Period

To change the aging timeout period, use the following command:

```
set fdb agingtime vlan-id age seconds
```

For example, to set the aging timeout period for VLAN 2 to 600 seconds, type the following command:

```
WX1200# set fdb agingtime 2 age 600
success: change accepted.
```

Port and VLAN Configuration Scenario

This scenario assigns names to ports, and configures MAP access ports, wired authentication ports, a load-sharing port group, and VLANs.

1. Assign names to ports to identify their functions, and verify the configuration change. Type the following commands:

```
WX1200# set port 1 name mgmt
success: change accepted.
WX1200# set port 2 name finance
success: change accepted.
WX1200# set port 3 name accounting
success: change accepted.
WX1200# set port 4 name shipping
success: change accepted.
WX1200# set port 5-6 name lobby
success: change accepted.
WX1200# set port 7-8 name conf_room1
success: change accepted.
WX1200# display port status
Port  Name            Admin  Oper    Config    Actual    Type       Media
===============================================================================
   1  mgmt            up     up      auto      100/full  network    10/100BaseTx
   2  finance         up     down    auto                network    10/100BaseTx
   3  accounting      up     down    auto                network    10/100BaseTx
   4  shipping        up     down    auto                network    10/100BaseTx
   5  lobby           up     down    auto                network    10/100BaseTx
   6  lobby           up     down    auto                network    10/100BaseTx
   7  conf_room1      up     down    auto                network    10/100BaseTx
   8  conf_room1      up     down    auto                network    10/100BaseTx
```

2. Configure the country code for operation in the US and verify the configuration change. Type the following commands:

```
WX1200# set system countrycode US
success: change accepted.
WX1200# display system
===============================================================================
 Product Name:       WX1200
 System Name:        WX1200
 System Countrycode: US
 System Location:
 System Contact:
 System IP:          0.0.0.0
 System idle timeout: 3600
 System MAC:         00:0B:0E:00:04:0C
```

```
===============================================================================
 Boot Time:          2000-03-18 22:59:19
 Uptime:                 0 days 00:13:45
===============================================================================
 Fan status:  fan1 OK fan2 OK fan3 OK
 Temperature: temp1 ok  temp2 ok  temp3 ok
 PSU Status:  Lower Power Supply DC ok AC ok  Upper Power Supply missing
 Memory:      156.08/496.04 (31%)
 Total Power Over Ethernet : 0.000
===============================================================================
```

3 Configure ports 2 through 4 for connection to MAP model AP2750 and verify the configuration changes. Type the following commands:

```
WX1200# set port type ap 2-4 model ap2750 poe enable
This may affect the power applied on the configured ports.
Would you like to continue? (y/n) [n]y
success: change accepted.
WX1200# display port status
Port  Name             Admin  Oper    Config    Actual    Type       Media
===============================================================================
   1  mgmt             up     up      auto      100/full  network    10/100BaseTx
   2  finance          up     up      auto      100/full  ap         10/100BaseTx
   3  accounting       up     up      auto      100/full  ap         10/100BaseTx
   4  shipping         up     up      auto      100/full  ap         10/100BaseTx
   5  lobby            up     up      auto      100/full  network    10/100BaseTx
   6  lobby            up     up      auto      100/full  network    10/100BaseTx
   7  conf_room1       up     up      auto      100/full  network    10/100BaseTx
   8  conf_room1       up     up      auto      100/full  network    10/100BaseTx
WX1200# display port poe
                      Link     Port    PoE       PoE
Port  Name            Status   Type    config    Draw(Watts)
===============================================================================
   1  mgmt             up       -       disabled  off
   2  finance          up       MAP     enabled    7.11
   3  accounting       up       MAP     enabled    7.11
   4  shipping         up       MAP     enabled    7.11
   5  lobby            up       -       disabled  off
   6  lobby            up       -       disabled  off
```

4 Configure ports 5 and 6 as wired authentication ports and verify the configuration change. Type the following commands:

```
WX1200# set port type wired-auth 5,6
success: change accepted
WX1200# display port status
Port  Name            Admin  Oper    Config    Actual    Type       Media
===============================================================================
   1  mgmt            up     up      auto      100/full  network    10/100BaseTx
   2  finance         up     up      auto      100/full  ap         10/100BaseTx
   3  accounting      up     up      auto      100/full  ap         10/100BaseTx
   4  shipping        up     up      auto      100/full  ap         10/100BaseTx
   5  lobby           up     up      auto      100/full  wired auth 10/100BaseTx
   6  lobby           up     up      auto      100/full  wired auth 10/100BaseTx
   7  conf_room1      up     up      auto      100/full  network    10/100BaseTx
   8  conf_room1      up     up      auto      100/full  network    10/100BaseTx
```

5 Configure ports 7 and 8 as a load-sharing port group to provide a redundant link to the backbone, and verify the configuration change. Type the following commands:

```
WX1200# set port-group name backbonelink port 7,8 mode on
success: change accepted.
WX1200# display port-group
Port group: backbonelink is up
        Ports:  7, 8
```

6 Add port 1 to the *default* VLAN (VLAN 1) and verify the configuration change. Type the following commands:

```
WX1200# set vlan default port 1
success: change accepted.
WX1200# display vlan config
                      Admin  VLAN  Tunl                        Port
VLAN Name             Status State Affin Port             Tag   State
---- ---------------- ------ ----- ----- ---------------- ----- -----
   1 default          Up     Up        5
                                          1                none Up
4094 web-aaa          Up     Up        0
                                          2                4094 Up
```

7 Save the configuration. Type the following command:

```
WX1200# save config
success: configuration saved.
```

6

CONFIGURING AND MANAGING IP INTERFACES AND SERVICES

This chapter describes how to configure IP interfaces and services.

MTU Support

Mobility System Software (MSS) supports standard maximum transmission units (MTUs) of 1514 bytes for standard Ethernet packets and 1518 bytes for Ethernet packets with an 802.1Q tag. MSS does not support changing of the MTU through software configuration, and MSS does not do path MTU discovery.

Communication between WX switches is supported over any path MTU, and the Mobility Domain itself can run over the minimum IP path MTU (PMTU). However, tunnels between two WX switches require a path MTU of at least 1384 bytes.

This minimum MTU path is required because MSS uses IP tunnels to transport user traffic between WX switches and to transport user traffic and control traffic between switches and MAPs. Encapsulation of the packets for tunneling adds an additional 44 bytes to the packet headers, so MSS does fragment and reassemble the packets if necessary to fit within the supported MTUs. However, MSS does not support defragmentation except at the receiving end of an IP tunnel, and only to reassemble fragments created by another WX switch device for tunneling.

If the path MTU between WX switches is less than 1384 bytes, a device in the path might further fragment or drop a tunneled packet. If the packet is further fragmented, the receiving WX switch will not be able to reassemble the fragments, and the packet is dropped.

Configuring and Managing IP Interfaces

Many features, including the following, require an IP interface on the WX switch:

- Management access through Telnet
- Access by 3Com Wireless Switch Manager
- Exchanging information and user data with other WX switches in a Mobility Domain

IP interfaces are associated with VLANs. At least one VLAN on a WX switch must have an IP interface to provide management access. Optionally, the other VLANs configured on the switch also can each have an IP interface. Each IP interface must belong to a unique, nonoverlapping IP subnet.

Adding an IP Interface

You can add an IP interface to a VLAN by statically configuring an IP address or by enabling the Dynamic Host Configuration Protocol (DHCP) client on the VLAN.

Statically Configuring an IP Interface

To add an IP interface to a VLAN, use the following command:

```
set interface vlan-id ip {ip-addr mask | ip-addr/mask-length}
```

Enabling the DHCP Client

The MSS DHCP client enables a WX switch to obtain its IP configuration from a DHCP server. A switch can use the DHCP client to obtain the following configuration information:

- IP address
- Default router (gateway)
- DNS domain name
- DNS server IP address

The DHCP client is implemented according to “RFC 2131: Dynamic Host Configuration Protocol” and “RFC 2132: DHCP Options and BOOTP Vendor Extensions”. The client supports the following options:

- (12) Host Name (the WX system name)
- (55) Parameter request list, consisting of (1) Subnet Mask, (3) Router, (15) Domain Name, and (6) Domain Name Server
- (60) Vendor Class Identifier, set to *3comx.x.x*, where *x.x.x* is the MSS version

The DHCP client is enabled by default on an unconfigured WXR100 when the factory reset switch is pressed and held during power on. The DHCP client is disabled by default on all other switch models, and is disabled on a WXR100 if the switch is already configured or the factory reset switch is not pressed and held during power on.

You can enable the DHCP client on one VLAN only.

MSS also has a configurable DHCP server. (See "Configuring the DHCP Server" on page 665.) You can configure a DHCP client and DHCP server on the same VLAN, but only the client or the server can be enabled. The DHCP client and DHCP server cannot both be enabled on the same VLAN at the same time.

How MSS Resolves Conflicts with Statically Configured IP Parameters MSS compares the IP parameter values already configured on the switch with the values received from the DHCP server, and resolves any conflicts as follows:

- IP address—If the VLAN also has a statically configured IP address, MSS uses an address from the DHCP server instead of the statically configured address.

  MSS sends an ARP for the IP address offered by the DHCP server to verify that the address is not already in use.

  - If the address is not in use, MSS configures the VLAN that has the DHCP client enabled with the IP address received from the DHCP server. MSS then configures the other values as follows:
    - Default router—MSS adds a default route for the gateway, with a metric of 10.
    - DNS domain name and DNS server IP address—If the default domain name and DNS server IP address are already configured on the switch, and DNS is enabled, the configured values are used. Otherwise, the values received from the DHCP server are used.
  - If the address offered by the DHCP server is already in use, MSS sends a DHCP Decline message to the server and generates a log message.
  - If the address is in a subnet that is already configured on another VLAN on the switch, MSS sends a DHCP Decline message to the server and generates a log message.

If the switch is powered down or restarted, MSS does not retain the values received from the DHCP server. However, if the IP interface goes down but MSS is still running, MSS attempts to reuse the address when the interface comes back up.

Configuring the DHCP Client To configure the DHCP client on a VLAN, use the following command:

```
set interface vlan-id ip dhcp-client {enable | disable}
```

The *vlan-id* can be the VLAN name or number.

The following command enables the DHCP client on VLAN *corpvlan*:

```
WX1200# set interface corpvlan ip dhcp-client enable
success: change accepted.
```

You can configure the DHCP client on more than one VLAN, but the client can be active on only one VLAN.

To remove all IP information from a VLAN, including the DHCP client and user-configured DHCP server, use the following command:

```
clear interface vlan-id ip
```

This command clears all IP configuration information from the interface.

The IP interface table flags the address assigned by a DHCP server with an asterisk (*). In the following example, VLAN *corpvlan* received IP address 10.3.1.110 from a DHCP server.

```
WX1200# display interface
* = From DHCP
VLAN Name            Address         Mask            Enabled State RIB
---- --------------- --------------- --------------- ------- ----- --------
   4 corpvlan        *10.3.1.110     255.255.255.0   YES     Up    ipv4
```

Displaying DHCP Client Information To display DHCP client information, type the following command:

```
WX1200# display dhcp-client
 Interface:              corpvlan(4)
 Configuration Status: Enabled
 DHCP State:             IF_UP
 Lease Allocation:       65535 seconds
 Lease Remaining:        65532 seconds
 IP Address:             10.3.1.110
 Subnet Mask:            255.255.255.0
 Default Gateway:        10.3.1.1
 DHCP Server:            10.3.1.4
 DNS Servers:            10.3.1.29
 DNS Domain Name:        mycorp.com
```

Disabling or Reenabling an IP Interface

IP interfaces are enabled by default. To administratively disable or reenable an IP interface, use the following command:

```
set interface vlan-id status {up | down}
```

Removing an IP Interface

To remove an IP interface, use the following command:

```
clear interface vlan-id ip
```

CAUTION: *If you remove the IP interface that is being used as the system IP address, features that require the system IP address will not work correctly.*

Displaying IP Interface Information

To display IP interface information, use the following command:

```
display interface [vlan-id]
```

Configuring the System IP Address

You can designate one of the IP addresses configured on a WX switch to be the system IP address of the switch. The system IP address determines the interface or source IP address MSS uses for system tasks, including the following:

- Mobility Domain operations
- Topology reporting for dual-homed MAPs
- Default source IP address used in unsolicited communications such as AAA accounting reports and SNMP traps

Designating the System IP Address

To designate the system IP address, use the following command:

```
set system ip-address ip-addr
```

Displaying the System IP Address

To display the system IP address, use the following command.

```
display system
```

Clearing the System IP Address

To clear the system IP address, use the following command:

```
clear system ip-address
```

CAUTION: *Clearing the system IP address disrupts the features that use the address.*

Configuring and Managing IP Routes

The IP route table contains routes that MSS uses for determining the interfaces for a WX switch's external communications. When you add an IP interface to a VLAN that is up, MSS automatically adds corresponding entries to the IP route table.

For destination routes that are not directly attached, you can add static routes. A static route specifies the destination and the default router through which to forward traffic.You can add the following types of static routes:

- **Explicit route** — Forwarding path for traffic to a specific destination
- **Default route** — Forwarding path for traffic to a destination without an explicit route in the route table

A destination can be a subnet or network. If two static routes specify a destination, the more specific route is always chosen (longest prefix match). For example, if you have a static route with a destination of 10.10.1.0/24, and another static route with a destination of 10.10.0.0/16, the first static route is chosen to reach 10.10.1.15, because it has the longer prefix match.

If the IP route table contains an explicit route for a given destination, MSS uses the route. Otherwise, MSS uses a default route. For example, if the route table does not have a route to host 192.168.1.10, the WX switch uses the default route to forward a packet addressed to that host. 3Com recommends that you configure at least one default route.

You can configure a maximum of four routes per destination. This includes default routes, which have destination 0.0.0.0/0. Each route to a given destination must have a unique gateway address. When the route table contains multiple default routes or multiple explicit routes to the same destination, MSS uses the route with the lowest metric (cost for using the route). If two or more routes to the same destination have the lowest cost, MSS selects the first route in the route table.

MSS can use a route only if the route is resolved by a direct route on one of the WX switch's VLANs.

*Before you add a static route, use the **display interface** command to verify that the switch has an IP interface in the same subnet as the route's default router (gateway). MSS requires the routes for the interface to resolve the static route. If the switch does not have an interface in the default router's subnet, the static route cannot be resolved and the VLAN:Interface field of the **display ip route** command output shows that the static route is down.*

Displaying IP Routes

To display IP routes, use the following command:

```
display ip route [destination]
```

The *destination* parameter specifies a destination IP address.

To display the IP route table, type the following command:

```
WX1200# display ip route
Router table for IPv4
Destination/Mask   Proto   Metric NH-Type Gateway         VLAN:Interface
__________________ _______ ______ _______ _______________ _______________

        0.0.0.0/ 0 Static       1 Router  10.0.1.17       vlan:1:ip
        0.0.0.0/ 0 Static       2 Router  10.0.2.17       vlan:2:ip
       10.0.1.1/24 IP           0 Direct                  vlan:1:ip
       10.0.1.1/32 IP           0 Local                   vlan:1:ip:10.0.1.1/24
     10.0.1.255/32 IP           0 Local                   vlan:1:ip:10.0.1.1/24
       10.0.2.1/24 IP           0 Direct                  vlan:2:ip
       10.0.2.1/32 IP           0 Local                   vlan:2:ip:10.0.1.1/24
     10.0.2.255/32 IP           0 Local                   vlan:2:ip:10.0.1.1/24
      224.0.0.0/ 4 IP           0 Local                   MULTICAST
```

This example shows dynamic routes added by MSS for two VLAN interfaces, 10.0.1.1/24 on VLAN 1 and 10.0.2.1/24 on VLAN 2.

This example also shows two static routes, which have a next-hop type (NH-Type) value of Router. Static routes have a default router, listed in the Gateway field. The 0.0.0.0 destination represents a default route. Here, default router 10.0.1.17 is reachable through the subnet on VLAN 1. Route 10.0.1.1/24 resolves the static route that uses the default router. Default router 10.0.2.17 is reachable through the subnet on VLAN 2 and route 10.0.2.1/24 resolves the static route to that gateway.

MSS adds routes with next-hop types Direct and Local when you add an IP interface to a VLAN, when the VLAN is up. Direct routes are for the locally attached subnets that the switch’s IP addresses are in. Local routes are for destination interfaces configured on the WX switch itself.

MSS automatically adds the 224.0.0.0 route to support the IGMP snooping feature.

If a VLAN is administratively disabled or all of the links in the VLAN go down or are disabled, MSS removes the VLAN's routes from the route table. If the direct route required by a static route goes down, MSS changes the static route state to Down. If the route table contains other static routes to the same destination, MSS selects the resolved route that has the lowest cost. In the following example, the default route to 10.0.1.17 is down, so MSS selects the default route to 10.0.2.17.

```
WX1200# display ip route
Router table for IPv4
Destination/Mask    Proto   Metric NH-Type Gateway         VLAN:Interface

__________________ _______ ______ _______ _______________ _______________

        0.0.0.0/ 0 Static       1 Router  10.0.1.17       Down
        0.0.0.0/ 0 Static       2 Router  10.0.2.17       vlan:2:ip
       10.0.2.1/24 IP           0 Direct                  vlan:2:ip
       10.0.2.1/32 IP           0 Direct                  vlan:2:ip:10.0.1.1/24
     10.0.2.255/32 IP           0 Direct                  vlan:2:ip:10.0.1.1/24
      224.0.0.0/ 4 IP           0 Local                   MULTICAST
```

(For more information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Adding a Static Route

To add a static route, use the following command:

set ip route {**default** | *ip-addr mask* | *ip-addr***/***mask-length*} *default-router metric*

The metric (cost) can be any number between 0 and 2,147,483,647. Lower-cost routes are preferred over higher-cost routes. When you add multiple routes to the same destination, MSS groups the routes together and orders them from lowest cost at the top of the group to highest cost at the bottom of the group. If you add a new route that has the same destination and cost as a route already in the table, MSS places the new route at the top of the group of routes with the same cost.

To add a default route that uses default router 10.5.4.1 and has a cost of 1, type the following command:

```
WX1200# set ip route default 10.5.4.1 1
success: change accepted.
```

To add two default routes and configure MSS to always use the route through 10.2.4.69 when the WX interface to that default router is up, type the following commands:

```
WX1200# set ip route default 10.2.4.69 1
success: change accepted.
WX1200# set ip route default 10.2.4.17 2
success: change accepted.
```

To add an explicit route from a WX switch to any host on the 192.168.4.*x* subnet through the local router 10.5.4.2, and give the route a cost of 1, type the following command:

```
WX1200# set ip route 192.168.4.0 255.255.255.0 10.5.4.2 1
success: change accepted.
```

Removing a Static Route

To remove a static route, use the following command:

```
clear ip route {default | ip-addr mask | ip-addr/mask-length}
default-router
```

After you remove a route, traffic that uses the route can no longer reach its destination. For example, if you are managing the WX switch with a Telnet session and the session needs the static route, removing the route also removes the Telnet connection to the switch.

The following command removes the route to 192.168.4.69/24 that uses default router 10.2.4.1:

```
WX1200# clear ip route 192.168.4.69/24 10.2.4.1
success: change accepted.
```

The following command removes the default route that uses default router 10.5.5.5:

```
WX1200# clear ip route default 10.5.5.5
success: change accepted.
```

Managing the Management Services

MSS provides the following services for managing a WX switch over the network:

- **Secure Shell (SSH)** — SSH provides a secure connection to the CLI through TCP port 22.
- **Telnet** — Telnet provides a nonsecure connection to the CLI through TCP port 23.
- **HTTPS** — HTTPS provides a secure connection to the Web management application through TCP port 443.

SSH is enabled by default. Telnet and HTTPS are disabled by default.

A WX switch can have up to eight Telnet or SSH sessions, in any combination, and one Console session. A WXR100 can have up to four Telnet or SSH sessions, in any combination, and one Console session.

Managing SSH

MSS supports Secure Shell (SSH) Version 2. SSH provides secure management access to the CLI over the network. SSH requires a valid username and password for access to the switch. When a user enters a valid username and password, SSH establishes a management session and encrypts the session data.

Login Timeouts

When you access the SSH server on a WX switch, MSS allows you 10 seconds to press Enter for the username prompt. After the username prompt is displayed, MSS allows 30 seconds to enter a valid username and password to complete the login. If you do not press Enter or complete the login before the timer expires, MSS ends the session. These timers are not configurable.

To ensure that all CLI management sessions are encrypted, after you configure SSH, disable Telnet.

Enabling SSH

SSH is enabled by default. To disable or reenable it, use the following command:

```
set ip ssh server {enable | disable}
```

SSH requires an SSH authentication key. You can generate one or allow MSS to generate one. The first time an SSH client attempts to access the SSH server on a WX switch, the switch automatically generates a 1024-byte SSH key. If you want to use a 2048-byte key instead, use the following command to generate one:

```
WX1200# crypto generate key ssh 2048
key pair generated
```

If a key has already been generated, the command replaces the old key with a new one. The new key takes affect for all new SSH sessions.

You can verify the key using the following command:

```
display crypto key ssh
```

For example:

```
WX1200# display crypto key ssh
ec:6f:56:7f:d1:fd:c0:28:93:ae:a4:f9:7c:f5:13:04
```

This command displays the checksum (also called a *fingerprint*) of the public authentication key. When you initially connect to the WX switch with an SSH client, you can compare the SSH key checksum displayed by the WX switch with the one displayed by the client to verify that you really are connected to the WX switch and not another device. Generally, SSH clients remember the encryption key after the first connection, so you need to check the key only once.

The WX switch stores the key in nonvolatile storage where the key remains even after software reboots.

Adding an SSH User

To log in with SSH, a user must supply a valid username and password. To add a username and password to the local database, use the following command:

```
set user username password password
```

Optionally, you also can configure MSS either to locally authenticate the user or to use a RADIUS server to authenticate the user. Use the following command:

```
set authentication admin {user-glob}
method1 [method2] [method3] [method4]
```

To add administrative user *wxadmin* with password *letmein*, and use RADIUS server group *sg1* to authenticate the user, type the following commands:

```
WX1200# set user wxadmin password letmein
success: User wxadmin created
WX1200# set authentication admin wxadmin sg1
success: change accepted
```

(For more information, see "Adding and Clearing Local Users for Administrative Access" on page 59.)

Changing the SSH Service Port Number

To change the SSH port the WX switch listens on for SSH connections, use the following command:

```
set ip ssh port port-num
```

CAUTION: *If you change the SSH port number from an SSH session, MSS immediately ends the session. To open a new management session, you must configure the SSH client to use the new SSH port number.*

Managing SSH Server Sessions

Use the following commands to manage SSH server sessions:

```
display sessions admin
clear sessions admin ssh [session-id]
```

These commands display and clear SSH server sessions.

*If you type the **clear sessions admin ssh** command from within an SSH session, the session ends as soon as you press Enter.*

To display the SSH server sessions on a WX switch, type the following command:

```
WX1200# display sessions admin
Tty         Username              Time (s)    Type
-------     --------------------  --------    ----
tty0                              3644        Console
tty2        tech                  6           Telnet
tty3        sshadmin              381         SSH

3 admin sessions
```

To clear all SSH server sessions, type the following command:

```
WX1200# clear sessions admin ssh
This will terminate manager sessions,
do you wish to continue? (y|n) [n]y
Cleared ssh session on tty3
```

(To manage Telnet client sessions, see "Logging In to a Remote Device" on page 132.)

Managing Telnet

Telnet requires a valid username and password for access to the switch.

Telnet Login Timers

After the username prompt is displayed, MSS allows 30 seconds to enter a valid username and password to complete the login. If you do not press Enter or complete the login before the timer expires, MSS ends the session. This timer is not configurable.

Enabling Telnet

Telnet is disabled by default. To enable Telnet, use the following command:

```
set ip telnet server {enable | disable}
```

Adding a Telnet User

To log in with Telnet, a user must supply a valid username and password. To add a username and password to the local database, use the following command:

```
set user username password password
```

Optionally, you also can configure MSS either to locally authenticate the user or to use a RADIUS server to authenticate the user. Use the following command:

```
set authentication admin {user-glob}
method1 [method2] [method3] [method4]
```

You can use the same username and password for SSH or create a new one. For a CLI example, see "Adding an SSH User" on page 114.

Displaying Telnet Status

To display the status of the Telnet server, use the following command:

```
display ip telnet
```

To display the Telnet server status and the TCP port number on which a WX switch listens for Telnet traffic, type the following command:

```
WX1200> display ip telnet
Server Status                 Port
----------------------------------
Enabled                         3
```

Changing the Telnet Service Port Number

To change the TCP port the WX switch listens on for Telnet connections, use the following command:

```
set ip telnet port-num
```

***CAUTION:** If you change the Telnet port number from a Telnet session, MSS immediately ends the session. To open a new management session, you must Telnet to the switch with the new Telnet port number.*

Resetting the Telnet Service Port Number to Its Default

To reset the Telnet management service to its default TCP port, use the following command:

```
clear ip telnet
```

Managing Telnet Server Sessions

Use the following commands to manage Telnet server sessions:

```
display sessions admin
clear sessions admin telnet [session-id]
```

These commands display and clear management sessions from a remote client to the WX switch's Telnet server.

*If you type the **clear sessions admin telnet** command from within a Telnet session, the session ends as soon as you press Enter.*

To display the Telnet server sessions on a WX switch, type the following command:

```
WX1200# display sessions admin
Tty         Username                    Time (s)    Type
-------     --------------------        --------    ----
tty0                                    3644        Console
tty2        tech                        6           Telnet
tty3        sshadmin                    381         SSH

3 admin sessions
```

To clear all Telnet server sessions, type the following command:

```
WX1200# clear sessions telnet
This will terminate manager sessions,
do you wish to continue? (y|n) [n]y
Cleared telnet session on tty2
```

(To manage Telnet client sessions, see "Logging In to a Remote Device" on page 132.)

Managing HTTPS

Enabling HTTPS

HTTPS is disabled by default. To enable HTTPS, use the following command:

```
set ip https server {enable | disable}
```

CAUTION: *If you disable the HTTPS server, Web View access to the switch is also disabled.*

Displaying HTTPS Information

To display HTTPS service information, use the following command:

```
display ip https
```

To display information for a WX switch's HTTPS server, type the following command:

```
WX1200> display ip https
HTTPS is enabled
HTTPS is set to use port 443
Last 10 Connections:
 IP Address     Last Connected          Time Ago (s)
------------    ----------------------- ------------
10.10.10.56     2003/05/09 15:51:26 pst          349
```

The command lists the TCP port number on which the switch listens for HTTPS connections. The command also lists the last 10 devices to establish HTTPS connections with the switch and when the connections were established.

If a browser connects to a WX switch from behind a proxy, then only the proxy IP address is shown. If multiple browsers connect using the same proxy, the proxy address appears only once in the output.

Changing the Idle Timeout for CLI Management Sessions

By default, MSS automatically terminates a console or Telnet session that is idle for more than one hour. To change the idle timeout for CLI management sessions, use the following command:

```
set system idle-timeout seconds
```

You can specify from 0 to 86400 seconds (one day). The default is 3600 (one hour). If you specify 0, the idle timeout is disabled. The timeout interval is in 30-second increments. For example, the interval can be 0, or 30 seconds, or 60 seconds, or 90 seconds, and so on. If you enter an interval that is not divisible by 30, the CLI rounds up to the next 30-second increment. For example, if you enter 31, the CLI rounds up to 60.

This command applies to all types of CLI management sessions: console, Telnet, and SSH. The timeout change applies to new sessions only.

The following command sets the idle timeout to 1800 seconds (one half hour):

```
WX1200# set system idle-timeout 1800
success: change accepted.
```

To reset the idle timeout to its default value, use the following command:

```
clear system idle-timeout
```

To display the current setting (if the timeout has been changed from the default), use the **display config area system** command. If you are not certain whether the timeout has been changed, use the **display config all** command.

Setting a Message of the Day (MOTD) Banner

You can configure the WX switch to display a Message of the Day (MOTD) banner, which is a string of text that is displayed before the beginning of the login prompt for a user's CLI session. The MOTD banner can be a message to users, or legal and government-mandated warning messages.

To specify a MOTD banner, use the following command:

```
set banner motd "text"
```

The MOTD banner text can be up to 4096 characters in length, enclosed in delimiting characters, for example double quotes (**"**).

The following command sets the MOTD banner on the WX:

```
WX# set banner motd "Meeting @ 4:00 p.m. in Conference Room #3"
success: motd changed.
```

To display the configured MOTD banner text, use the following command:

```
display banner motd
```

To clear the MOTD banner from the WX configuration, use the following command:

```
clear banner motd
```

Prompting the User to Acknowledge the MOTD Banner

Optionally, you can prompt the user to acknowledge the MOTD banner by entering *y* to continue. To do this, use the following commands:

```
set banner acknowledge mode {enable | disable}
set banner acknowledge message "message"
```

The *message* is displayed at the end of the MOTD, and can be up to 32 characters in length. In response, the user has the option of entering *y* to proceed or any other key to terminate the connection.

The following command enables the prompt for the MOTD banner:

```
WX# set banner acknowledge enable
success: change accepted.
```

The following command sets *Do you agree?* as the text to be displayed following the MOTD banner:

```
WX# set banner acknowledge message 'Do you agree?'
success: change accepted.
```

After these commands are entered, when the user logs on, the MOTD banner is displayed, followed by the text *Do you agree?* If the user enters *y*, then the login proceeds; if not, then the user is disconnected.

Configuring and Managing DNS

You can configure a WX switch to use a Domain Name Service (DNS) server to resolve hostnames into their IP addresses. This capability is useful in cases where you specify a hostname instead of an IP address in a command.

For example, as an alternative to the command **ping 192.168.9.1**, you can enter the command **ping chris.example.com**. When you enter **ping chris.example.com**, the WX switch's DNS client queries a DNS server for the IP address that corresponds to the hostname *chris.example.com*, then sends the ping request to that IP address.

The WX switch’s DNS client is disabled by default. To configure DNS:

- Enable the DNS client.
- Specify the IP addresses of the DNS servers.
- Configure a default domain name for DNS queries.

Enabling or Disabling the DNS Client

The DNS client is disabled by default. To enable or disable the DNS client, use the following command:

```
set ip dns {enable | disable}
```

Configuring DNS Servers

You can configure a WX switch to use one primary DNS server and up to five secondary DNS servers to resolve DNS queries.

The WX switch always sends a request to the primary DNS server first. The WX switch sends a request to a secondary DNS server only if the primary DNS server does not respond.

Adding a DNS Server

To add a DNS server, use the following command:

```
set ip dns server ip-addr {primary | secondary}
```

Removing a DNS Server

To remove a DNS server, use the following command:

```
clear ip dns server ip-addr
```

Configuring a Default Domain Name

You can configure a single default domain name for DNS queries. The WX switch appends the default domain name to hostnames you enter in commands. For example, you can configure the WX switch to automatically append the domain name *example.com* to any hostname that does not have a domain name. In this case, you can enter **ping chris** instead of **ping chris.example.com**, and the WX switch automatically requests the DNS server to send the IP address for *chris.example.com*.

To override the default domain name when entering a hostname in a CLI command, enter a period at the end of the hostname. For example, if the default domain name is *example.com*, enter **chris.** if the hostname is *chris* and not *chris.example.com*.

Aliases take precedence over DNS. When you enter a hostname, MSS checks for an alias with that name first, before using DNS to resolve the name. (For information about aliases, see "Configuring and Managing Aliases" on page 123.)

Adding the Default Domain Name

To add the default domain name, use the following command:

```
set ip dns domain name
```

Specify a domain name of up to 64 alphanumeric characters.

Removing the Default Domain Name

To remove the default domain name, use the following command:

```
clear ip dns domain
```

Displaying DNS Server Information

To display DNS server information, use the following command:

```
display ip dns
```

The following example shows DNS server information on a WX switch configured to use three DNS servers.

```
WX1200# display ip dns
Domain Name: example.com
DNS Status: enabled
IP Address                 Type
-----------------------------------
10.1.1.1                   PRIMARY
10.1.1.2                   SECONDARY
10.1.2.1                   SECONDARY
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Configuring and Managing Aliases

An alias is a string that represents an IP address. You can use aliases as shortcuts in CLI commands. For example, you can configure alias *pubs1* for IP address 10.10.10.20, and enter **ping pubs1** as a shortcut for **ping 10.10.10.20**.

Aliases take precedence over DNS. When you enter a hostname, MSS checks for an alias with that name first, before using DNS to resolve the name.

Adding an Alias

To add an alias, use the following command:

```
set ip alias name ip-addr
```

Specify an alias of up to 32 alphanumeric characters.

To add an alias *HR1* for IP address 192.168.1.2, type the following command:

```
WX1200# set ip alias HR1 192.168.1.2
success: change accepted.
```

After configuring the alias, you can use *HR1* in commands in place of the IP address. For example, to ping 192.168.1.2, you can type the command **ping HR1**.

Removing an Alias

To remove an alias, use the following command:

```
clear ip alias name
```

Displaying Aliases

To display aliases, use the following command:

```
display ip alias [name]
```

Here is an example:

```
WX1200# display ip alias
Name                     IP Address
--------------------     --------------------
HR1                      192.168.1.2
payroll                  192.168.1.3
radius1                  192.168.7.2
```

Configuring and Managing Time Parameters

You can configure the system time and date statically or by using Network Time Protocol (NTP) servers. In each case, you can specify the offset from Coordinated Universal Time (UTC) by setting the time zone. You also can configure MSS to offset the time by an additional hour for daylight savings time or similar summertime period.

3Com recommends that you set the time and date parameters before you install certificates on the WX switch. If the switch's time and date are incorrect, the certificate might not be valid.

Generally, CA-generated certificates are valid for one year beginning with the system time and date that are in effect when you generate the certificate request. Self-signed certificates generated when running MSS Version 4.2.3 or later are valid for three years, beginning one week before the time and date on the switch when the certificate is generated.

If you do not install certificates, the switch automatically generates them the first time you boot the switch with MSS Version 4.2 or later. The automatically generated certificates are dated based on the time and date information present on the switch when it was first booted with MSS Version 4.2.

To statically set the time and date:

- Set the time zone (**set timezone** command)
- Set the summertime period (**set summertime** command)
- Set the time and date (**set timedate** command)

Configure summertime before you set the time and date. Otherwise, summertime's adjustment of the time will make the time incorrect, if the date is within the summertime period.

To use NTP servers to set the time and date:

- Set the time zone (**set timezone** command)
- Set the summertime period (**set summertime** command)
- Configure NTP server information (**set ntp** commands)

Setting the Time Zone

The time zone parameter adjusts the system date, and optionally the time, by applying an offset to UTC.

To set the time zone, use the following command:

```
set timezone zone-name {-hours [minutes]}
```

The zone name can be up to 32 alphanumeric characters long, with no spaces. The *hours* parameter specifies the number of hours to add to or subtract from UTC. Use a minus sign (-) in front of the hour value to subtract the hours from UTC.

To set the time zone to *PST* (Pacific Standard Time), type the following command:

```
WX1200# set timezone PST -8
Timezone is set to 'PST', offset from UTC is -8:0 hours.
```

Displaying the Time Zone

To display the time zone, use the following command:

```
display timezone
```

For example, to display the time zone, type the following command:

```
WX1200# display timezone
Timezone set to 'PST', offset from UTC is -8 hours
```

Clearing the Time Zone

To clear the time zone, use the following command:

```
clear timezone
```

Configuring the Summertime Period

The summertime period offsets the system time +1 hour and returns it to standard time for daylight savings time or a similar summertime period that you set.

Configure summertime before you set the time and date. Otherwise, summertime’s adjustment of the time will make the time incorrect, if the date is within the summertime period.

To configure the summertime period, use the following command:

```
set summertime summer-name
[start week weekday month hour min
end week weekday month hour min]
```

The *summer-name* can be up to 32 alphanumeric characters long, with no spaces. The start and end dates and times are optional. If you do not specify a start and end time, MSS implements the time change starting at 2:00 a.m. on the first Sunday in April and ending at 2:00 a.m. on the last Sunday in October, according to the North American standard.

To set the summertime period to *PDT* (Pacific Daylight Time) and use the default start and end dates and times, type the following command:

```
WX1200# set summertime PDT
success: change accepted.
```

Displaying the Summertime Period

To display the summertime period, use the following command:

```
display summertime
```

For example, to display the summertime period, type the following command:

```
WX1200# display summertime
Summertime is enabled, and set to 'PDT'.
  Start   : Sun Apr 04 2004, 02:00:00
  End     : Sun Oct 31 2004, 02:00:00
  Offset : 60 minutes
  Recurring : yes, starting at 2:00 am of first Sunday of
              April and ending at 2:00 am on last Sunday of
              October.
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Clearing the Summertime Period

To clear the summertime period, use the following command:

```
clear summertime
```

Statically Configuring the System Time and Date

To statically configure the system time and date, use the following command:

```
set timedate {date mmm dd yyyy [time hh:mm:ss]}
```

The day of week is automatically calculated from the day you set.

To set the date to February 29, 2004 and time to 23:58:

```
WX1200# set timedate date feb 29 2004 time 23:58:00
Time now is:              Sun Feb 29 2004, 23:58:02 PST
```

The CLI makes the time change, then displays the current system time based on the change. (The time displayed might be slightly later than the time you enter due to the interval between when you press Enter and when the CLI reads and displays the new time and date.)

Displaying the Time and Date

To display the time and date, use the following command:

```
display timedate
```

For example:

```
WX1200# display timedate
Sun Feb 29 2004, 23:58:02 PST
```

Configuring and Managing NTP

The Network Time Protocol (NTP) allows a networking device to synchronize its system time and date with the time and date on an NTP server. When used on multiple devices, NTP ensures that the time and date are consistent among those devices.

The NTP implementation in MSS is based on RFC 1305, *Network Time Protocol (Version 3) Specification, Implementation and Analysis*.

You can configure a WX switch to consult up to three NTP servers. The switch compares the results from the servers and selects the best response. (For information, see RFC 1305.)

After you enable the NTP client and configure NTP servers, MSS queries the NTP servers for an update every 64 seconds and waits 15 seconds for a reply. If the switch does not receive a reply to an NTP query within 15 seconds, the switch tries again up to 16 times. You can change the update interval but not the timeout or number of retries.

MSS adjusts the NTP reply according to the following time parameters configured on the WX switch:

- Offset from UTC (configured with the **timezone** command; see "Setting the Time Zone" on page 125)
- Daylight savings time (configured with the **set summertime** command; see "Configuring the Summertime Period" on page 125)

The NTP client is disabled by default.

If NTP is configured on a system whose current time differs from the NTP server time by more than 10 minutes, convergence of the WX time can take many NTP update intervals. 3Com recommends that you set the time manually to the NTP server time before enabling NTP to avoid a significant delay in convergence.

Adding an NTP Server

To add an NTP server to the list of NTP servers, use the following command:

```
set ntp server ip-addr
```

To configure a WX switch to use NTP server 192.168.1.5, type the following command:

```
WX1200# set ntp server 192.168.1.5
```

Removing an NTP Server

To remove an NTP server, use the following command:

```
clear ntp server {ip-addr | all}
```

If you use the **all** option, MSS clears all NTP servers configured on the switch.

Changing the NTP Update Interval

The default update interval is 64 seconds. To change the update interval, use the following command:

```
set ntp update-interval seconds
```

You can specify an interval from 16 through 1024 seconds.

For example, to change the NTP update interval to 128 seconds, type the following command:

```
WX1200# set ntp update-interval 128
success: change accepted.
```

Resetting the Update Interval to the Default

To reset the update interval to the default value, use the following command:

```
clear ntp update-interval
```

Enabling the NTP Client

The NTP client is disabled by default. To enable the NTP client, use the following command:

```
set ntp {enable | disable}
```

Displaying NTP Information

To display NTP information, use the following command:

```
display ntp
```

Here is an example:

```
WX1200> display ntp
NTP client: enabled
Current update-interval: 20(secs)
Current time: Sun Feb 29 2004, 23:58:12
Timezone is set to 'PST', offset from UTC is -8:0 hours.
Summertime is enabled.
Last NTP update: Sun Feb 29 2004, 23:58:00
NTP Server          Peer state          Local State
---------------------------------------------------
192.168.1.5         SYSPEER             SYNCED
```

The Timezone and Summertime fields are displayed only if you change the timezone or enable summertime.

(For more information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Managing the ARP Table

The Address Resolution Protocol (ARP) table maps IP addresses to MAC addresses. An ARP entry enters the table in one of the following ways:

- Added automatically by the WX switch. A switch adds an entry for its own MAC address and adds entries for addresses learned from traffic received by the WX switch. When the WX switch receives an IP packet, the switch adds the packet's source MAC address and source IP address to the ARP table.
- Added by the system administrator. You can add dynamic, static, and permanent entries to the ARP table.

ARP is enabled by default on a WX switch and cannot be disabled.

Displaying ARP Table Entries

To display ARP table entries, use the following command:

`display arp` *`[ip-addr]`*

Here is an example:

```
WX1200# display arp
ARP aging time: 1200 seconds

Host                           HW Address        VLAN  Type    State
------------------------------ ----------------- ----- ------- --------
10.5.4.51                      00:0b:0e:02:76:f5     1 DYNAMIC RESOLVED
10.5.4.53                      00:0b:0e:02:76:f7     1 LOCAL   RESOLVED
```

This example shows two entries. The local entry (with LOCAL in the Type field) is for the WX switch itself. The MAC address of the local entry is the switch's MAC address. The ARP table contains one local entry for each VLAN configured on the switch. The dynamic entry is learned from traffic received by the switch. The ARP table can also contain static and permanent entries, which are added by an administrator. The State field indicates whether an entry is resolved (RESOLVED) or whether MSS has sent an ARP request for the entry and is waiting for the reply (RESOLVING).

Adding an ARP Entry

MSS automatically adds a local entry for a WX switch and dynamic entries for addresses learned from traffic received by the switch. You can add the following types of entries:

- **Dynamic** — Ages out based on the aging timeout.
- **Static** — Does not age out but is removed by a software reboot.
- **Permanent** — Does not age out and remains in the ARP table following a software reboot.

To add an ARP entry, use the following command:

```
set arp {permanent | static | dynamic} ip-addr mac-addr
```

To add a static ARP entry that maps IP address 10.10.10.1 to MAC address 00:bb:cc:dd:ee:ff, type the following command:

```
WX1200# set arp static 10.10.10.1 00:bb:cc:dd:ee:ff
success: added arp 10.10.10.1 at 00:bb:cc:dd:ee:ff on VLAN 1
```

Changing the Aging Timeout

The aging timeout specifies how long a dynamic entry can remain unused before the software removes the entry from the ARP table. The default aging timeout is 1200 seconds (20 minutes). The aging timeout does not affect the local entry, static entries, or permanent entries.

To change the aging timeout, use the following command:

```
set arp agingtime seconds
```

You can specify from 0 to 1,000,000 seconds. To disable aging, specify 0.

For example, to disable aging of dynamic ARP entries, type the following command:

```
WX1200# set arp agingtime 0
success: set arp aging time to 0 seconds
```

To reset the ARP aging timeout to its default value, use the ***set arp agingtime 1200*** *command.*

Pinging Another Device

To verify that another device in the network can receive IP packets sent by the WX switch, use the following command:

```
ping host [count num-packets] [dnf] [flood] [interval time]
[size size] [source-ip ip-addr | vlan-name]
```

To ping a device that has IP address 10.1.1.1, type the following command:

```
WX1200# ping 10.1.1.1
PING 10.1.1.1 (10.1.1.1) from 10.9.4.34 : 56(84) bytes of data.
64 bytes from 10.1.1.1: icmp_seq=1 ttl=255 time=0.769 ms
64 bytes from 10.1.1.1: icmp_seq=2 ttl=255 time=0.628 ms
64 bytes from 10.1.1.1: icmp_seq=3 ttl=255 time=0.676 ms
64 bytes from 10.1.1.1: icmp_seq=4 ttl=255 time=0.619 ms
64 bytes from 10.1.1.1: icmp_seq=5 ttl=255 time=0.608 ms
--- 10.1.1.1 ping statistics ---
5 packets transmitted, 5 packets received, 0 errors, 0% packet loss
```

In this example, the ping is successful, indicating that the WX switch has IP connectivity with the other device.

A WX switch cannot ping itself. MSS does not support this.

(For information about the command options, see the *Wireless LAN Switch and Controller Command Reference*.)

Logging In to a Remote Device

From within an MSS console session or Telnet session, you can use the Telnet client to establish a Telnet client session from a WX switch's CLI to another device. To establish a Telnet client session with another device, use the following command:

```
telnet {ip-addr | hostname} [port port-num]
```

To establish a Telnet session from WX switch *WX1200* to 10.10.10.90, type the following command:

```
WX1200# telnet 10.10.10.90
Session 0 pty tty2.d Trying 10.10.10.90...
Connected to 10.10.10.90
Disconnect character is '^t'

Copyright (c) 2002, 2003
        3Com Corporation.

Username:
```

When you press Ctrl+t or type **exit** to end the client session, the management session returns to the local WX prompt:

```
WX1200-remote> Session 0 pty tty2.d terminated tt name tty2.d
WX1200#
```

Use the following commands to manage Telnet client sessions:

```
display sessions telnet client
clear sessions telnet client [session-id]
```

These commands display and clear Telnet sessions from a WX switch's Telnet client to another device.

To display the Telnet client sessions on a WX switch, type the following command:

```
WX1200# display sessions telnet client
Session   Server Address    Server Port    Client Port
-------   --------------    ------------   -----------
0          192.168.1.81     5             48000
1           10.10.1.22      5             48001
```

To clear Telnet client session 0, type the following command:

```
WX1200# clear sessions telnet client 0
```

You also can clear a Telnet client session by typing **exit** from within the client session.

Tracing a Route

You can trace the router hops necessary to reach an IP host.

The traceroute facility uses the TTL (Time to Live) field in the IP header to cause routers and servers to generate specific return messages. Traceroute starts by sending a UDP datagram to the destination host with the TTL field set to 1. If a router finds a TTL value of 1 or 0, it drops the datagram and sends back an ICMP *Time Exceeded* message to the sender.

The traceroute facility determines the address of the first hop by examining the source address field of the ICMP time-exceeded message.

To identify the next hop, traceroute again sends a UDP packet, but this time with a TTL value of 2. The first router decrements the TTL field by 1 and sends the datagram to the next router. The second router sees a TTL value of 1, discards the datagram, and returns the *Time Exceeded* message to the source. This process continues until the TTL is incremented to a value large enough for the datagram to reach the destination host (or until the maximum TTL is reached).

To determine when a datagram has reached its destination, traceroute sets the UDP destination port in the datagram to a very large value, one that the destination host is unlikely to be using. In addition, when a host receives a datagram with an unrecognized port number, it sends an ICMP *Port Unreachable* error to the source. This message indicates to the traceroute facility that it has reached the destination.

To trace a route to a destination subnet, use the following command:

```
traceroute host [dnf] [no-dns] [port port-num] [queries num]
[size size] [ttl hops] [wait ms]
```

To trace the route to host *server1*, type the following command:

```
WX1200# traceroute server1
traceroute to server1.example.com (192.168.22.7), 30 hops max, 38 byte packets
1 engineering-1.example.com (192.168.192.206) 2 ms 1 ms 1 ms
2 engineering-2.example.com (192.168.196.204) 2 ms 3 ms 2 ms
3 gateway_a.example.com (192.168.1.201) 6 ms 3 ms 3 ms
4 server1.example.com (192.168.22.7) 3 ms * 2 ms
```

In this example, *server1* is four hops away. The hops are listed in order, beginning with the hop that is closest to the WX switch and ending with the route's destination. (For information about the command options, see the *Wireless LAN Switch and Controller Command Reference*.)

IP Interfaces and Services Configuration Scenario

This scenario configures IP interfaces, assigns one of the interfaces to be the system IP address, and configures a default route, DNS parameters, and time and date parameters.

1 Configure IP interfaces on the *mgmt* and *roaming* VLANs, and verify the configuration changes. Type the following commands:

```
WX1200# set interface mgmt ip 10.10.10.10/24
success: change accepted.
WX1200# set interface roaming ip 10.20.10.10/24
success: change accepted.
WX1200# display interface
VLAN Name            Address         Mask            Enabled State
---- --------------- --------------- --------------- ------- -----
   2 default         10.10.10.10     255.255.255.0   YES     Up
   3 roaming         10.20.10.10     255.255.255.0   YES     Up
4094 web-aaa         10.10.10.1      255.255.255.0   YES     Up
```

The 10.10.10.1 interface in VLAN web-aaa is placed into the route table automatically by MSS, to support WebAAA.

2 Configure the IP interface on the *roaming* VLAN to be the system IP address and verify the configuration change. Type the following commands:

```
WX1200# set system ip-address 10.20.10.10
success: change accepted.
WX1200# display system
===============================================================================
 Product Name:       WX1200
 System Name:        WX1200
 System Countrycode: US
 System Location:
 System Contact:
 System IP:          10.02.10.10
 System idle timeout:3600
 System MAC:         00:0B:0E:00:04:0C
===============================================================================
 Boot Time:          2000-03-18 22:59:19
 Uptime:                 0 days 01:12:02
===============================================================================
 Fan status:  fan1 OK fan2 OK fan3 OK
 Temperature: temp1 ok  temp2 ok  temp3 ok
 PSU Status:  Lower Power Supply DC ok AC ok  Upper Power Supply missing
 Memory:      156.08/496.04 (31%)
 Total Power Over Ethernet : 105.6
===============================================================================
```

3. Configure a default route through a default router attached to the WX switch and verify the configuration change. Type the following commands:

```
WX1200# set ip route default 10.20.10.1 1
success: change accepted.
WX1200# display ip route
Router table for IPv4
Destination/Mask   Proto   Metric NH-Type Gateway         VLAN:Interface
__________________ _______ ______ _______ _______________ _______________
        0.0.0.0/ 0 Static       1 Router  10.20.10.1
    10.10.10.10/24 IP           0 Direct                  vlan:1:ip
    10.10.10.10/32 IP           0 Local                   vlan:1:ip:10.10.10.10/24
    10.20.10.10/24 IP           0 Direct                  vlan:1:ip
    10.20.10.10/32 IP           0 Local                   vlan:1:ip:10.20.10.10/24
     224.0.0.0/ 4  IP           0 Local                   MULTICAST
```

4. Configure the DNS domain name and DNS server entries, enable the DNS service, and verify the configuration changes. Type the following commands:

```
WX1200# set ip dns domain example.com
success: change accepted.
WX1200# set ip dns server 10.10.10.69 PRIMARY
success: change accepted.
WX1200# set ip dns server 10.20.10.69 SECONDARY
success: change accepted.
WX1200# set ip dns enable
success: change accepted.
WX1200# display ip dns
Domain Name: example.com
DNS Status: enabled
IP Address                Type
-----------------------------------
10.10.10.69               PRIMARY
10.20.10.69               SECONDARY
```

5. Configure time zone, summertime, and NTP parameters and verify the configuration changes. Type the following commands:

```
WX1200# set timezone PST -8
success: change accepted.
WX1200# display timezone
Timezone is set to 'PST', offset from UTC is -8:0 hours.
WX1200# set summertime PDT
success: change accepted.
```

```
WX1200# display summertime
Summertime is enabled, and set to 'PDT'.
  Start  : Sun Apr 04 2004, 02:00:00
  End    : Sun Oct 31 2004, 02:00:00
  Offset : 60 minutes
  Recurring : yes, starting at 2:00 am of first Sunday of
April and
ending at 2:00 am on last Sunday of October.
WX1200# set ntp server 192.168.1.5
WX1200# set ntp enable
success: NTP Client enabled
WX1200# display ntp
NTP client: enabled
Current update-interval: 20(secs)
Current time: Sun Feb 29 2004, 23:58:12
Timezone is set to 'PST', offset from UTC is -8:0 hours.
Summertime is enabled.
Last NTP update: Sun Feb 29 2004, 23:58:00
NTP Server          Peer state          Local State
---------------------------------------------------
192.168.1.5         SYSPEER             SYNCED
WX1200# display timedate
Sun Feb 29 2004, 23:59:02 PST
```

6 Save the configuration. Type the following command:

```
WX1200# save config
success: configuration saved.
```

7 CONFIGURING SNMP

MSS supports Simple Network Management Protocol (SNMP) versions 1, 2c, and 3.

Overview

The MSS SNMP engine (also called the SNMP *server* or *agent*) can run any combination of the following SNMP versions:

- SNMPv1—SNMPv1 is the simplest and least secure SNMP version. Community strings are used for authentication. Communications are in the clear (not encrypted). Notifications are traps, which are not acknowledged by the notification target (also called a *trap receiver*).
- SNMPv2c—SNMPv2 is similar to SNMPv1, but supports informs. An inform is a notification that is acknowledged by the notification target.
- SNMPv3—SNMPv3 adds authentication and encryption options. Instead of community strings, SNMPv3 supports user security model (USM) users, with individually configurable access levels, authentication options, and encryption options.

All SNMP versions are disabled by default.

Configuring SNMP

To configure SNMP, perform the following tasks:

- Set the switch's system IP address, if it is not already set. SNMP will not work without the system IP address. (See "Configuring the System IP Address" on page 108.)
- Optionally, set the system location and contact strings.
- Enable the SNMP version(s) you want to use. MSS can run one or more versions, in any combination.
- Configure community strings (for SNMPv1 or SNMPv2c) or USM users (for SNMPv3).

- Set the minimum level of security allowed for SNMP message exchanges.
- Configure a notification profile or modify the default one, to enable sending of notifications to notification targets. By default, notifications of all types are dropped (not sent).
- Configure notification targets.
- Enable the MSS SNMP engine.

Setting the System Location and Contact Strings

To set the location and contact strings for a switch, use the following commands:

```
set system location string
set system contact string
```

Each string can be up to 256 characters long, with no blank spaces.

The following commands set a WX switch's location to *3rd_floor_closet* and set the contact to *sysadmin1*:

```
WX4400# set system location 3rd_floor_closet
success: change accepted.
WX4400# set system contact sysadmin1
success: change accepted.
```

Enabling SNMP Versions

To enable an SNMP protocol, use the following command:

```
set snmp protocol {v1 | v2c | usm | all} {enable | disable}
```

The **usm** option enables SNMPv3. The **all** option enables all three versions of SNMP.

The following command enables all SNMP versions:

```
WX4400# set snmp protocol all enable
success: change accepted.
```

Configuring Community Strings (SNMPv1 and SNMPv2c Only)

To configure a community string for SNMPv1 or SNMPv2c, use the following command:

```
set snmp community name comm-string
access {read-only | read-notify | notify-only | read-write |
notify-read-write}
```

The *comm-string* can be up to 32 alphanumeric characters long, with no spaces. You can configure up to 10 community strings.

The access level specifies the read-write privileges of the community string:

- **read-only**—An SNMP management application using the string can get (read) object values on the switch but cannot set (write) them. This is the default.
- **read-notify**—An SNMP management application using the string can get object values on the switch but cannot set them. The switch can use the string to send notifications.
- **notify-only**—The switch can use the string to send notifications.
- **read-write**—An SNMP management application using the string can get and set object values on the switch.
- **notify-read-write**—An SNMP management application using the string can get and set object values on the switch. The switch can use the string to send notifications.

To clear an SNMP community string, use the following command:

```
clear snmp community name comm-string
```

The following command configures community string *switchmgr1* with access level `notify-read-write`:

```
WX1200# set snmp community name switchmgr1 notify-read-write
success: change accepted.
```

Creating a USM User for SNMPv3

To create a USM user for SNMPv3, use the following command:

```
set snmp usm usm-username
snmp-engine-id {ip ip-addr | local | hex hex-string}
access {read-only | read-notify | notify-only | read-write |
notify-read-write}
auth-type {none | md5 | sha} {auth-pass-phrase string |
auth-key hex-string}
encrypt-type {none | des | 3des | aes} {encrypt-pass-phrase
string | encrypt-key hex-string}
```

To clear a USM user, use the following command:

```
clear snmp usm usm-username
```

The *usm-username* can be up to 32 alphanumeric characters long, with no spaces. You can configure up to 20 SNMPv3 users.

The **snmp-engine-id** option specifies a unique identifier for an instance of an SNMP engine. To send informs, you must specify the engine ID of the inform receiver. To send traps and to allow get and set operations and so on, specify **local** as the engine ID.

- **hex** *hex-string*—ID is a hexadecimal string.
- **ip** *ip-addr*—ID is based on the IP address of the station running the management application. Enter the IP address of the station. MSS calculates the engine ID based on the address.
- **local**—Uses the value computed from the switch's system IP address.

The **access** option specifies the access level of the user. The options are the same as the access options for community strings. (See "Configuring Community Strings (SNMPv1 and SNMPv2c Only)" on page 140.) The default is **read-only**.

The **auth-type** option specifies the authentication type used to authenticate communications with the remote SNMP engine. You can specify one of the following:

- **none**—No authentication is used. This is the default.
- **md5**—Message-digest algorithm 5 is used.
- **sha**—Secure Hashing Algorithm (SHA) is used.

If the authentication type is **md5** or **sha**, you can specify a passphrase or a hexadecimal key.

- To specify a passphrase, use the **auth-pass-phrase** *string* option. The string can be from 8 to 32 alphanumeric characters long, with no spaces.
- To specify a key, use the **auth-key** *hex-string* option. Type a 16-byte hexadecimal string for MD5 or a 20-byte hexadecimal string for SHA.

The **encrypt-type** option specifies the encryption type used for SNMP traffic. You can specify one of the following:

- **none**—No encryption is used. This is the default.
- **des**—Data Encryption Standard (DES) encryption is used.

- **3des**—Triple DES encryption is used.
- **aes**—Advanced Encryption Standard (AES) encryption is used.

If the encryption type is **des**, **3des**, or **aes**, you can specify a passphrase or a hexadecimal key.

- To specify a passphrase, use the **encrypt-pass-phrase** *string* option. The string can be from 8 to 32 alphanumeric characters long, with no spaces. Type a string at least 8 characters long for DES or 3DES, or at least 12 characters long for AES.
- To specify a key, use the **encrypt-key** *hex-string* option. Type a 16-byte hexadecimal string.

Command Examples

The following command creates USM user *snmpmgr1*, associated with the local SNMP engine ID. This user can send traps to notification receivers.

```
WX1200# set snmp usm snmpmgr1 snmp-engine-id local
success: change accepted.
```

The following command creates USM user *securesnmpmgr1*, which uses SHA authentication and 3DES encryption with passphrases. This user can send informs to the notification receiver that has engine ID 192.168.40.2.

```
WX1200# set snmp usm securesnmpmgr1 snmp-engine-id ip
192.168.40.2 auth-type sha auth-pass-phrase myauthpword
encrypt-type 3des encrypt-pass-phrase mycryptpword
success: change accepted.
```

Setting SNMP Security

By default, MSS allows nonsecure SNMP message exchanges. You can configure MSS to require secure SNMP exchanges instead.

Depending on the level of security you want MSS to enforce, you can require authentication of message exchanges only, or of message exchanges and notifications. You also can require encryption in addition to authentication.

SNMPv1 and SNMPv2c do not support authentication or encryption. If you plan to use SNMPv1 or SNMPv2c, leave the minimum level of SNMP security set to **unsecured**.

To set the minimum level of security MSS requires for SNMP, use the following command:

```
set snmp security {unsecured | authenticated | encrypted |
auth-req-unsec-notify}
```

You can specify one of the following options:

- **unsecured**—SNMP message exchanges are not secure. This is the default, and is the only value supported for SNMPv1 and SNMPv2c. (This security level is the same as the noAuthNoPriv level described in SNMPv3 RFCs.)
- **authenticated**—SNMP message exchanges are authenticated but are not encrypted. (This security level is the same as the authNoPriv level described in SNMPv3 RFCs.)
- **encrypted**—SNMP message exchanges are authenticated and encrypted. (This security level is the same as the authPriv level described in SNMPv3 RFCs.)
- **auth-req-unsec-notify**—SNMP message exchanges are authenticated but are not encrypted, and notifications are neither authenticated nor encrypted.

Command Example The following command sets the minimum level of SNMP security allowed to authentication ***and*** encryption:

```
WX1200# set snmp security encrypted
success: change accepted.
```

Configuring a Notification Profile

A *notification profile* is a named list of all the notification types that can be generated by a switch, and for each notification type, the action to take (drop or send) when an event occurs.

A default notification profile (named *default*) is already configured in MSS. All notifications in the default profile are dropped by default. You can configure up to 10 notification profiles.

To modify the default notification profile or create a new one, use the following command:

```
set snmp notify profile {default | profile-name} {drop |
send} {notification-type | all}
```

To clear a notification profile, use the following command:

```
clear snmp notify profile profile-name
```

The *profile-name* can be up to 32 alphanumeric characters long, with no spaces. To modify the default notification profile, specify **default**.

The *notification-type* can be one of the following:

- **APBootTraps—**Generated when a MAP boots.
- **ApNonOperStatusTraps**—Generated to indicate a MAP radio is nonoperational.
- **ApOperRadioStatusTraps**—Generated when the status of a MAP radio changes.
- **APTimeoutTraps—**Generated when a MAP fails to respond to the WX switch.
- **AuthenTraps—**Generated when the WX switch's SNMP engine receives a bad community string.
- **AutoTuneRadioChannelChangeTraps—**Generated when the RF Auto-Tuning feature changes the channel on a radio.
- **AutoTuneRadioPowerChangeTraps—**Generated when the RF Auto-Tuning feature changes the power setting on a radio.
- **ClientAssociationFailureTraps—**Generated when a client's attempt to associate with a radio fails.
- **ClientAuthorizationSuccessTraps—**Generated when a client is successfully authorized.
- **ClientAuthenticationFailureTraps—**Generated when authentication fails for a client.
- **ClientAuthorizationFailureTraps—**Generated when authorization fails for a client.
- **ClientClearedTraps—**Generated when a client's session is cleared.
- **ClientDeAssociationTraps—**Generated when a client is dissociated from a radio.
- **ClientDot1xFailureTraps—**Generated when a client experiences an 802.1X failure.
- **ClientRoamingTraps—**Generated when a client roams.
- **CounterMeasureStartTraps—**Generated when MSS begins countermeasures against a rogue access point.
- **CounterMeasureStopTraps—**Generated when MSS stops countermeasures against a rogue access point.

- **DAPConnectWarningTraps**—generated when a Distributed MAP whose fingerprint has not been configured in MSS establishes a management session with the switch.
- **DeviceFailTraps—**Generated when an event with an Alert severity occurs.
- **DeviceOkayTraps—**Generated when a device returns to its normal state.
- **LinkDownTraps—**Generated when the link is lost on a port.
- **LinkUpTraps—**Generated when the link is detected on a port.
- **MichaelMICFailureTraps—**Generated when two Michael message integrity code (MIC) failures occur within 60 seconds, triggering Wi-Fi Protected Access (WPA) countermeasures.
- **MobilityDomainJoinTraps—**Generated when the WX switch is initially able to contact a mobility domain seed member, or can contact the seed member after a timeout.
- **MobilityDomainTimeoutTraps—**Generated when a timeout occurs after a WX switch has unsuccessfully tried to communicate with a seed member.
- **PoEFailTraps—**Generated when a serious PoE problem, such as a short circuit, occurs.
- **RFDetectAdhocUserTraps**—Generated when MSS detects an ad-hoc user.
- **RFDetectRogueAPTraps**—Generated when MS detects a rogue access point.
- **RFDetectRogueDisappearTraps**—Generated when a rogue access point is no longer being detected.
- **RFDetectClientViaRogueWiredAPTraps**—Generated when MSS detects, on the wired part of the network, the MAC address of a wireless client associated with a third-party AP.
- **RFDetectDoSPortTraps**—Generated when MSS detects an associate request flood, reassociate request flood, or disassociate request flood.
- **RFDetectDoSTraps**—Generated when MSS detects a DoS attack other than an associate request flood, reassociate request flood, or disassociate request flood.
- **RFDetectInterferingRogueAPTraps**—Generated when an interfering device is detected.

- **RFDetectInterferingRogueDisappearTraps**—Generated when an interfering device is no longer detected.
- **RFDetectSpoofedMacAPTraps**—Generated when MSS detects a wireless packet with the source MAC address of a 3Com MAP, but without the spoofed MAP's signature (fingerprint).
- **RFDetectSpoofedSsidAPTraps**—Generated when MSS detects beacon frames for a valid SSID, but sent by a rogue AP.
- **RFDetectUnAuthorizedAPTraps**—Generated when MSS detects the MAC address of an AP that is on the attack list.
- **RFDetectUnAuthorizedOuiTraps**—Generated when a wireless device that is not on the list of permitted vendors is detected.
- **RFDetectUnAuthorizedSsidTraps**—Generated when an SSID that is not on the permitted SSID list is detected.

To apply the configuration change to all notification types, specify **all**.

The **drop** or **send** option specifies the action that the SNMP engine takes with regard to notifications.

Command Examples

The following command changes the action in the default notification profile from **drop** to **send** for all notification types:

```
WX1200# set snmp notify profile default send all
success: change accepted.
```

The following commands create notification profile *snmpprof_rfdetect*, and change the action to **send** for all RF detection notification types:

```
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectAdhocUserTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectClientViaRogueWiredAPTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectDoSTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectAdhocUserTraps
success: change accepted.
```

```
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectInterferingRogueAPTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectInterferingRogueDisappearTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectRogueAPTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectRogueDisappearTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectSpoofedMacAPTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectSpoofedSsidAPTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectUnAuthorizedAPTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectUnAuthorizedOuiTraps
success: change accepted.
WX1200# set snmp notify profile snmpprof_rfdetect send
RFDetectUnAuthorizedSsidTraps
success: change accepted.
```

Configuring a Notification Target

A notification target is a remote device to which MSS sends SNMP notifications. You can configure the MSS SNMP engine to send confirmed notifications (informs) or unconfirmed notifications (traps). Some of the command options differ depending on the SNMP version and the type of notification you specify. You can configure up to 10 notification targets.

To configure a notification target for informs from SNMPv3, use the following command:

```
set snmp notify target target-num ip-addr[:udp-port-number]
usm inform user username
snmp-engine-id {ip | hex hex-string}
[profile profile-name]
[security {unsecured | authenticated | encrypted}]
[retries num]
[timeout num]
```

To configure a notification target for traps from SNMPv3, use the following command:

```
set snmp notify target target-num ip-addr[:udp-port-number]
usm trap user username
[profile profile-name]
[security {unsecured | authenticated | encrypted}]
```

To configure a notification target for informs from SNMPv2c, use the following command:

```
set snmp notify target target-num ip-addr[:udp-port-number]
v2c community-string inform
[profile profile-name]
[retries num]
[timeout num]
```

To configure a notification target for traps from SNMPv2c, use the following command:

```
set snmp notify target target-num ip-addr[:udp-port-number]
v2c community-string trap
[profile profile-name]
```

To configure a notification target for traps from SNMPv1, use the following command:

```
set snmp notify target target-num ip-addr[:udp-port-number]
v1 community-string
[profile profile-name]
```

To clear a notification target, use the following command:

```
clear snmp notify target target-num
```

The *target-num* is an ID for the target. This ID is local to the WX switch and does not need to correspond to a value on the target itself. You can specify a number from 1 to 10.

The *ip-addr*[**:***udp-port-number*] is the IP address of the server. You also can specify the UDP port number to send notifications to. The default is 162.

Use **v1**, **v2c**, or **usm** to specify the SNMP version.

The **inform** or **trap** option specifies whether the MSS SNMP engine expects the target to acknowledge notifications sent to the target by the WX switch. Use **inform** if you want acknowledgements. Use **trap** if you do not want acknowledgements. The **inform** option is applicable to SNMP version **v2c** or **usm** only.

The *username* is a USM username, and is applicable only when the SNMP version is **usm**. If the user will send informs rather than traps, you also must specify the **snmp-engine-id** of the target. Specify **ip** if the target's SNMP engine ID is based on its IP address. If the target's SNMP engine ID is a hexadecimal value, use **hex** *hex-string* to specify the value.

The *community-string* is applicable only when the SNMP version is **v1** or **v2c**.

The *profile-name* is the notification profile. The default is **default**.

The **security** option specifies the security level, and is applicable only when the SNMP version is **usm**:

- **unsecured**—Message exchanges are not authenticated, nor are they encrypted. This is the default.
- **authenticated**—Message exchanges are authenticated, but are not encrypted.
- **encrypted**—Message exchanges are authenticated and encrypted.

The **retries** and **timeout** options are applicable only when the SNMP version is **v2c** or **usm** and the notification type is **inform**. The **retries** option specifies the number of times the MSS SNMP engine will resend a notification that has not been acknowledged by the target. You can specify from 0 to 3 retries. The default is 0. The **timeout** option specifies the number of seconds MSS waits for acknowledgement of a notification. You can specify from 1 to 5 seconds. The default is 2.

Command Examples

The following command configures a notification target for acknowledged notifications:

```
WX1200# set snmp notify target 1 10.10.40.9 usm inform user
securesnmpmgr1 snmp-engine-id ip
success: change accepted.
```

This command configures target 1 at IP address 10.10.40.9. The target's SNMP engine ID is based on its address. The MSS SNMP engine will send notifications based on the default profile, and will require the target to acknowledge receiving them.

The following command configures a notification target for unacknowledged notifications:

```
WX1200# set snmp notify target 2 10.10.40.10 v1 trap
success: change accepted.
```

Enabling the SNMP Service

To enable the MSS SNMP service, use the following command:

```
set ip snmp server {enable | disable}
```

The following command enables the SNMP service:

```
WX1200# set ip snmp server enable
success: change accepted.
```

Displaying SNMP Information

You can display the following SNMP information:

- Version and status information
- Configured community strings
- User-based security model (USM) settings
- Notification targets
- SNMP statistics counters

Displaying SNMP Version and Status Information

To display SNMP version and status information, use the following command:

```
display snmp status
```

Displaying the Configured SNMP Community Strings

To display the configured SNMP community strings, use the following command:

```
display snmp community
```

Displaying USM Settings

To display USM settings, use the following command:

```
display snmp usm
```

Displaying Notification Profiles

To display notification profiles, use the following command:

```
display snmp notify profile
```

The command lists settings separately for each notification profile. The use count indicates how many notification targets use the profile. For each notification type, the command lists whether MSS sends notifications of that type to the targets that use the notification profile.

Displaying Notification Targets

To display a list of the SNMP notification targets, use the following command:

```
display snmp notify target
```

Displaying SNMP Statistics Counters

To display SNMP statistics counters, use the following command:

```
display snmp counters
```

8

CONFIGURING AND MANAGING MOBILITY DOMAIN ROAMING

A Mobility Domain is a system of WX switches and managed access points (MAPs) working together to support roaming wireless users (clients). Tunnels and virtual ports between the WX switches in a Mobility Domain allow users to roam without any disruption to network connectivity.

About the Mobility Domain Feature

A Mobility Domain enables users to roam geographically across the system while maintaining their data sessions and VLAN or subnet membership, including IP address, regardless of how the WX switches are attached to the network backbone. As users move from one area of a building or campus to another, their association with servers or other resources appears the same.

When users access a WX switch in a Mobility Domain, they become members of the VLAN designated through their authorized identity. If a user's native VLAN is not present on the WX that he or she accesses, the accessed WX forms a tunnel to a WX in the Mobility Domain that includes the native VLAN.

In a Mobility Domain, one WX switch acts as a seed device, which distributes information to the WX switches defined in the Mobility Domain. Otherwise, the seed WX switch operates like any other Mobility Domain member.

(If your Mobility Domain uses firewalls or access controls between WX switches or AAA servers, see "Traffic Ports Used by MSS" on page 661 for the ports typically used in a Mobility Domain.)

3Com recommends that you run the same MSS version on all the WX *switches in a Mobility Domain.*

Configuring a Mobility Domain

The WX switches in a Mobility Domain use their system IP address for Mobility Domain communication. To support the services of the Mobility Domain, the system IP address of every WX switch requires basic IP connectivity to the system IP address of every other WX switch. (For information about setting the system IP address for the WX switch, see "Configuring the System IP Address" on page 108.)

To create a Mobility Domain:

1. Designate a seed WX switch. (See "Configuring the Seed" on page 154.)
2. Create a list of the member WX switches. (See "Configuring Member WX Switches on the Seed" on page 155.)
3. Configure each member WX switch to point to the seed. (See "Configuring a Member" on page 155.)
4. Optionally configure a redundant seed WX switch. (See "Configuring a Member" on page 155.)

You can view the status and configuration of a Mobility Domain, clear members, and clear all Mobility Domain configuration from a WX switch.

Configuring the Seed

You must explicitly configure *only one* WX switch per domain as the primary seed. All other WX switches in the domain receive their Mobility Domain information from the seed.

Use the following command to set the current WX switch as the seed device and name the Mobility Domain:

```
set mobility-domain mode seed domain-name mob-domain-name
```

For example, the following command sets the current WX switch as the seed and names the Mobility Domain *Pleasanton*:

```
WX1200# set mobility-domain mode seed domain-name Marlborough
success: change accepted.
```

The Mobility Domain name is assigned to the seed WX switch only. The WX switch system IP address is used as the source IP address for all Mobility Domain communications. If the system IP address is not set, MSS issues a warning when you enter the **set mobility-domain mode seed** *domain-name* command, to inform you that the Mobility Domain is not operational until the system IP is set.

Optionally, you can configure a redundant seed WX switch, which takes over seed duties if the primary seed becomes unavailable. See "Configuring Mobility Domain Seed Redundancy" on page 156.

Configuring Member WX Switches on the Seed

To configure the list of members on the Mobility Domain seed for distribution to other member WX switches, use the following command on the seed WX switch:

```
set mobility-domain member ip-addr
```

For example, the following commands add two members with IP addresses 192.168.12.7 and 192.168.15.5 to a Mobility Domain whose seed is the current WX:

```
WX1200# set mobility-domain member 192.168.12.7
success: change accepted.
WX1200# set mobility-domain member 192.168.15.5
success: change accepted.
```

Each command adds a member identified by its IP address to the list of Mobility Domain members. If the WX switch from which you enter the command is not configured as a seed, the command is rejected.

Configuring a Member

To configure a member WX switch in the Mobility Domain, you enter the following command when logged in to the nonseed member WX switch:

```
set mobility-domain mode member seed-ip ip-addr
```

This command configures the IP destination address that the member WX switch uses when communicating with the seed WX switch.

For example, the following command configures the current WX switch as a member of the Mobility Domain whose seed is 192.168.253.6:

```
WX1200# set mobility-domain mode member seed-ip 192.168.253.6
success: change accepted.
```

This command sets the WX switch as a member of the Mobility Domain defined on the seed device at the identified address. If the WX switch is currently part of another Mobility Domain or using another seed, this command overwrites that configuration. After you enter this command, the member WX switch obtains a new list of members from its new seed's IP address.

Configuring Mobility Domain Seed Redundancy

You can optionally specify a *secondary seed* in a Mobility Domain. The secondary seed provides redundancy for the primary seed switch in the Mobility Domain. If the primary seed becomes unavailable, the secondary seed assumes the role of the seed switch. This allows the Mobility Domain to continue functioning if the primary seed becomes unavailable.

Specifying a secondary seed for a Mobility Domain is useful since it eliminates the single point of failure that can occur if connectivity to the seed switch is lost.

When the primary seed switch fails, the remaining members form a Mobility Domain, with the secondary seed taking over as the primary seed switch.

- If countermeasures had been in effect on the primary seed, they are stopped while the secondary seed gathers RF data from the member switches. Once the secondary seed has rebuilt the RF database, countermeasures can be restored.
- VLAN tunnels (other than those between the member switches and the primary seed) continue to operate normally.
- Roaming and session statistics continue to be gathered, providing that the primary seed is uninvolved with roaming.

When the primary seed is restored, it resumes its role as the primary seed switch in the Mobility Domain. The secondary seed returns to its role as a regular member of the Mobility Domain.

Use the following commands to configure a Mobility Domain consisting of a primary seed, secondary seed, and one or more member switches:

On the primary seed:

```
set mobility-domain mode seed domain-name mob-domain-name
set mobility-domain member ip-addr (for each member switch)
```

On the secondary seed:

```
set mobility-domain mode secondary-seed domain-name
mob-domain-name seed-ip primary-seed-ip-addr
set mobility-domain member ip-addr (for each member switch)
```

On the other member switches in the Mobility Domain:

```
set mobility-domain mode member seed-ip primary-seed-ip-addr
set mobility-domain mode member secondary-seed-ip
secondary-seed-ip-addr
```

Displaying Mobility Domain Status

To view the status of the Mobility Domain for the WX switch, use the **display mobility-domain** command. For example:

```
WX# display mobility-domain
Mobility Domain name: pleasanton
Member           State         Type (*:active) Model    Version
---------------- ------------- --------------- -------- ----------
10.8.121.101     STATE_DOWN    SEED            WX-2200   6.0.0.0
10.8.121.102     STATE_UP      SECONDARY-SEED* WX-2200   6.0.0.0
10.8.121.103     STATE_UP      MEMBER          WX-2200   6.0.0.0
10.8.121.104     STATE_UP      MEMBER          WX-2200   6.0.0.0
```

Displaying the Mobility Domain Configuration

To view the configuration of the Mobility Domain, use the **display mobility-domain config** command on either the seed or a nonseed member.

- To view Mobility Domain configuration on the seed:

```
WX1200# display mobility-domain config
This WX is the seed for domain Pleasanton.
192.168.12.7 is a member
192.168.15.5 is a member
```

- To view Mobility Domain configuration on a member:

```
WX1200# display mobility-domain config
This WX is a member, with seed 192.168.14.6
```

Clearing a Mobility Domain from a WX Switch

You can clear all Mobility Domain configuration from a WX switch, regardless of whether the WX switch is a seed or a member of a Mobility Domain.s.

You might want to clear the Mobility Domain to change a WX switch from one Mobility Domain to another, or to remove a WX switch from the Mobility Domain. To clear the Mobility Domain, type the following command:

```
WX1200# clear mobility-domain
success: change accepted
```

This command has no effect if the WX switch is not configured as part of a Mobility Domain.

Clearing a Mobility Domain Member from a Seed

You can remove individual members from the Mobility Domain on the seed WX switch. To remove a specific member of the Mobility Domain, type the following command:

```
clear mobility-domain member ip-addr
```

This command has no effect if the WX switch member is not configured as part of a Mobility Domain or the current WX switch is not the seed.

Configuring WX-WX Security

You can enhance security on your network by enabling WX-WX security. WX-WX security encrypts management traffic exchanged by WX switches in a Mobility Domain.

When WX-WX security is enabled, management traffic among WX switches in the Mobility Domain is encrypted using AES. The keying material is dynamically generated for each session and passed among switches using public keys that you configure.

To configure WX-WX security:

- Set Mobility Domain security on each switch to **required**. The default setting is **none**. WX-WX security can be disabled or enabled on a Mobility Domain basis. The feature must have the same setting (required or none) on all switches in the Mobility Domain. Use the following command on the seed and on each member to enable WX-WX security:

  ```
  set domain security required
  ```

  This command also creates a certificate.

- On the Mobility Domain seed, specify the public key for each member. Use the following command:

  ```
  set mobility-domain member ip-addr key hex-bytes
  ```

  Specify the key as 16 hexadecimal bytes, separated by colons. Here is an example:

  ```
  00:11:22:33:44:55:66:77:88:99:aa:bb:cc:dd:ee:ff
  ```

- On each member switch, specify the seed's IP address and its public key. Use the following command:

  ```
  set mobility-domain mode member seed-ip ip-addr key
  hex-bytes
  ```

  This command does not need to be entered on the seed switch.

- On the seed and on each member, generate a private key. Use the following command:

  ```
  crypto generate key domain 128
  ```

Monitoring the VLANs and Tunnels in a Mobility Domain

Tunnels connect WX switches. Tunnels are formed automatically in a Mobility Domain to extend a VLAN to the WX switch that a roaming station is associated with. A single tunnel can carry traffic for many users and many VLANs. The tunnel port can carry traffic for multiple VLANs by means of multiple *virtual ports*.

MSS automatically adds virtual ports to VLANs as needed to preserve the associations of users to the correct subnet or broadcast domain as they roam across the Mobility Domain. Although tunnels are formed by IP between WX switches, the tunnels can carry user traffic of any protocol type.

MSS provides the following commands to display the roaming and tunneling of users within their Mobility Domain groups:

- **display roaming station** (See "Displaying Roaming Stations" on page 159.)
- **display roaming vlan** (See "Displaying Roaming VLANs and Their Affinities" on page 160.)
- **display tunnel** (See "Displaying Tunnel Information" on page 160.)

Displaying Roaming Stations

The command **display roaming station** displays a list of the stations roaming to the WX switch through a VLAN tunnel. To display roaming stations (clients), type the following command:

```
WX1200# display roaming station
User Name              Station Address   VLAN            State
---------------------- ----------------- --------------- -----
example\geetha         192.168.15.104    vlan-am         Up
nh@example.com         192.168.15.1990   vlan-am         Up
example\tamara         192.168.11.200    vlan-ds         Up
example\jose           192.168.14.200    vlan-et         Up
hh@example.com         192.168.15.194    vlan-am         Up
```

(For more information about this command and the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Roaming VLANs and Their Affinities

The command **display roaming vlan** displays all VLANs in the Mobility Domain, the WX switches servicing the VLANs, and their tunnel *affinity* values configured on each switch for the VLANs.

The member WX switch that offers the requested VLAN reports the affinity number. If multiple WX switches have native attachments to the VLAN, the affinity values they advertise are a way to attract tunneled traffic to a particular WX switch for that VLAN. A higher value represents preferred connection to the VLAN. (For more information, see "Changing Tunneling Affinity" on page 93.)

To display roaming VLANs, type the following command:

```
WX1200# display roaming vlan
VLAN             WX               Affinity
---------------- ---------------- --------
vlan-eng         192.168.12.7            5
vlan-fin         192.168.15.5            5
vlan-pm          192.168.15.5            5
vlan-wep         192.168.12.7            5
vlan-wep         192.168.15.5            5
```

(For more information about this command and the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Tunnel Information

The command **display tunnel** displays the tunnels that the WX switch is hosting to distribute to a locally attached VLAN. To display tunnel information, type the following command:

```
WX1200# display tunnel
VLAN             Local Address    Remote Address   State    Port  LVID  RVID
---------------- ---------------- ---------------- -------- ----- ----  ---
vlan-eng         192.168.12.7     192.168.15.5     UP        1024   130  4103
vlan-eng         192.168.12.7     192.168.14.6     DORMANT   1026   130  4097
vlan-pm          192.168.12.7     192.168.15.5     UP        1024  4096   160
```

(For more information about this command and the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Understanding the Sessions of Roaming Users

When a wireless client successfully roams from one MAP to another, its sessions are affected in the following ways:

- The WX treats this client session as a roaming session and not a new session.
- RADIUS accounting is handled as a continuation of an existing session, rather than a new one.
- The session with the roamed-from MAP is cleared from the WX, even if the client does not explicitly disassociate from the MAP and the IEEE 802.1X reauthentication period has not expired.

Roaming requires certain conditions and can be affected by some of the WX switch's timers. You can monitor a wireless client's roaming sessions with the **display sessions network verbose** command.

Requirements for Roaming to Succeed

For roaming to take place, the roaming client must associate or reassociate with a MAP in the Mobility Domain after leaving an existing session on a different MAP in the Mobility Domain in one of the following states:

- **ACTIVE** — The normal state for a client that has left radio range without sending a request to disassociate.
- **DEASSOCIATED** — The state of a client that has sent an 802.11 disassociate message, but has not roamed or aged out yet.

In addition, the following conditions must exist for roaming to succeed:

- Mobility Domain communications must be stable.

  Generally, the communications required for roaming are the same as those required for VLAN tunneling. A client can also roam among ports on a WX when a Mobility Domain is inaccessible or not configured.
- Client authentication and authorization on the roamed-to MAP must be successful on the first attempt.

  If authentication or authorization fails, MSS clears the client session. Depending on when the failure occurs, roaming can be disqualified or delayed.
- The client must use the same authorization parameters for the roamed-to MAP as for the roamed-from MAP.

  If the client changes its encryption type or VLAN name, MSS might record a new session rather than a roamed session.

Effects of Timers on Roaming

An unsuccessful roaming attempt might be caused by the following timers. You cannot configure either timer.

- **Grace period** — A disassociated session has a grace period of 5 seconds during which MSS can retrieve and forward the session history. After 5 seconds, MSS clears the session, and its accounting is stopped.
- **MAC address search** — If MSS cannot find the client's MAC address in a Mobility Domain within 5 seconds, it treats the session as a new session rather than a roaming session.

In contrast, the 802.1X reauthentication timeout period has little effect on roaming. If the timeout expires, MSS performs 802.1X processing on the existing association. Accounting and roaming history are unaffected when reauthentication is successful, because the client is still associated with the same MAP. If reauthentication fails, MSS clears the session so it is not eligible for roaming.

If the client associates with the same MAP, the session is recorded as a new session. (To change the reauthentication timeout, see "Setting the 802.1X Reauthentication Period" on page 537.)

Monitoring Roaming Sessions

To monitor the state of roaming clients, use the **display sessions network verbose** command. For example, the following command displays information about the sessions of a wireless client who roamed between the ports on a WX switch.

The output shows that the client *SHUTTLE\2\exmpl* roamed from the MAP connected to port 3 to the MAP connected to port 6 on the same WX, and then roamed back to the MAP connected to port 3.

```
WX1200> display sessions network verbose
User                           Sess  IP or MAC         VLAN            Port/
Name                             ID  Address           Name            Radio
------------------------------ ----  ----------------- --------------- -----
SHUTTLE2\exmpl                   6* 10.3.8.55         default          3/1
Client MAC: 00:06:25:13:08:33   GID: SESS-4-000404-98441-c807c14b
State: ACTIVE                  (prev AUTHORIZED)
now on: WX 10.3.8.103, AP/radio  3/1, AP 00:0b:0e:ff:00:3a, as of 00:00:24 ago
  from: WX 10.3.8.103, AP/radio  6/1, AP 00:0b:0e:00:05:d7, as of 00:01:07 ago
  from: WX 10.3.8.103, AP/radio  3/1, AP 00:0b:0e:ff:00:3a, as of 00:01:53 ago
1 sessions total
```

(For more information about this command and the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Mobility Domain Scenario

The following scenario illustrates how to create a Mobility Domain named *sunflower* consisting of three members from a seed WX switch at 192.168.253.21:

1. Make the current WX switch the Mobility Domain seed. Type the following command:

```
WX1200# set mobility-domain mode seed domain-name sunflower
success: change accepted.
```

2. On the seed, add the members of the Mobility Domain. Type the following commands:

```
WX1200# set mobility-domain member 192.168.253.11
success: change accepted.
WX1200# set mobility-domain member 192.168.111.112
success: change accepted.
```

3. For each member WX switch, configure the IP address used to reach the seed WX switch. Type the following commands:

```
WX1200# set mobility-domain member seed-ip 192.168.253.21
```

4. Display the Mobility Domain status. Type the following command:

```
WX1200# display mobility-domain
Mobility Domain name:  sunflower
Member                State              Status
---------------       -------------      --------------
192.168.111.112       STATE_UP           MEMBER
192.168.253.11        STATE_UP           MEMBER
192.168.253.21        STATE_UP           SEED
```

5. To display the Mobility Domain configuration, type the following command:

```
WX1200# display mobility-domain config
This WX is the seed for domain sunflower.
192.168.253.11 is a member
192.168.111.112 is a member
```

6. To display the WX switches that are hosting VLANs for roaming, type the following command:

```
WX1200# display roaming vlan
VLAN             WX              Affinity
---------------- --------------- --------
vlan-eng         192.168.12.7           5
vlan-fin         192.168.15.5           5
vlan-pm          192.168.15.5           5
```

```
vlan-wep         192.168.12.7           5
vlan-wep         192.168.15.5           5
```

7 To display active roaming tunnels, type the following command:

```
WX1200# display tunnel
VLAN             Local Address   Remote Address  State    Port  LVID  RVID
-------------- --------------- --------------- ------- ----- ----- -----
vlan-eng         192.168.12.7    192.168.15.5    UP       1025   130  4096
vlan-eng         192.168.12.7    192.168.14.6    UP       1024   130  4096
```

9

CONFIGURING NETWORK DOMAINS

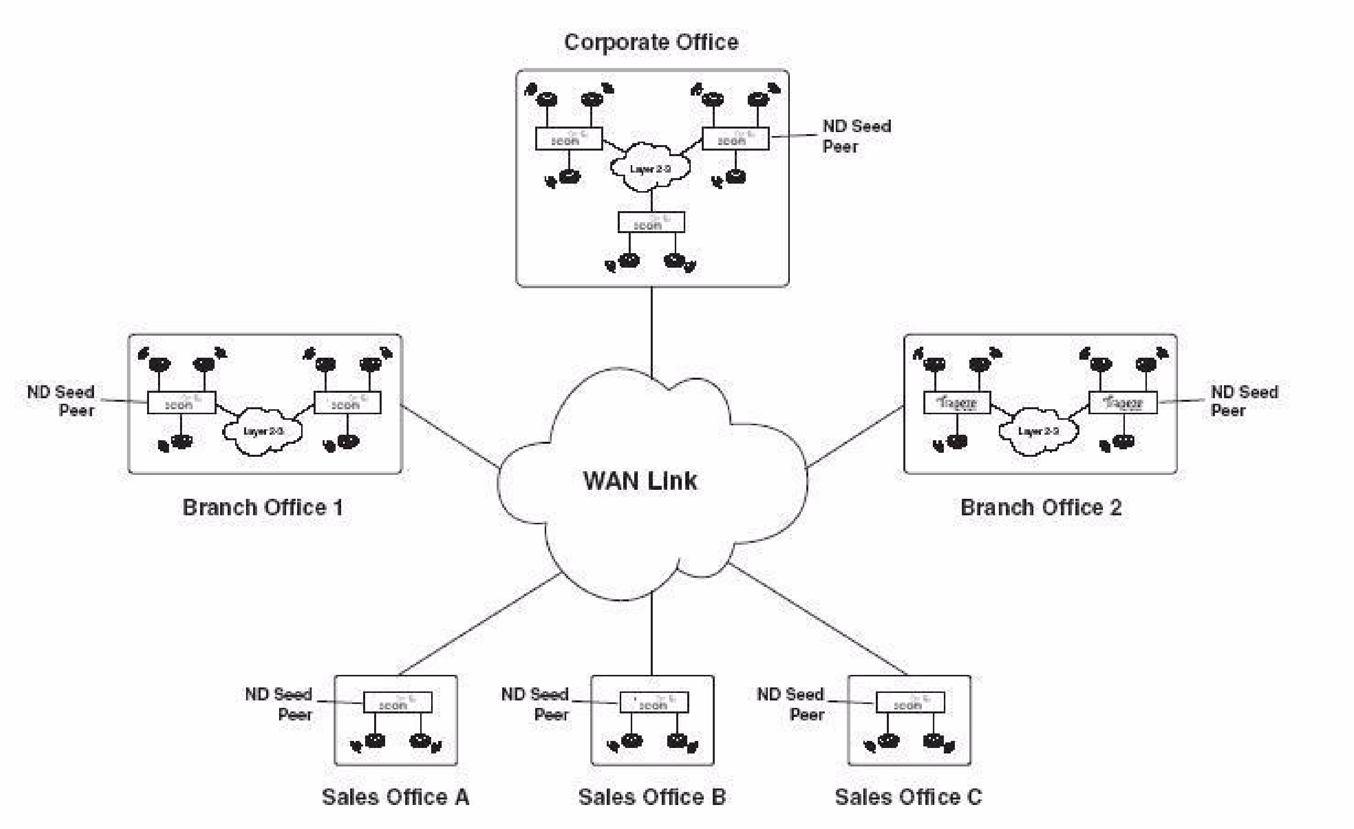
A Network Domain is a group of geographically dispersed Mobility Domains that share information over a WAN link. This shared information allows a user configured in one Mobility Domain to establish connectivity on a WX switch in a remote Mobility Domain. The WX switch forwards the user traffic by creating a VLAN tunnel to a WX switch in the remote Mobility Domain.

About the Network Domain Feature

A Network Domain allows functionality found in Mobility Domains to be extended over a multiple-site installation. A user configured to be on a VLAN at his or her home site can travel to a remote site, connect to the network, and be placed in his or her native VLAN. To do this, the WX switch that the user accesses forms a tunnel to a WX switch at the user's home site.

Figure 4 illustrates a sample Network Domain configuration consisting of Mobility Domains at six sites connected over a WAN link.

Figure 4 Network Domain

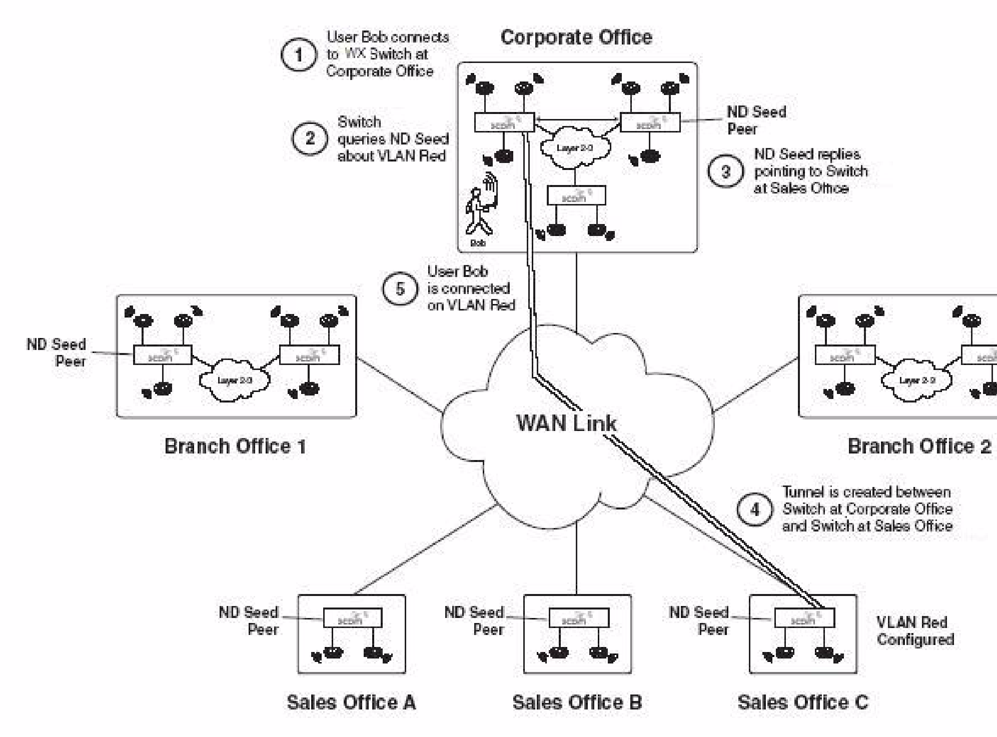

Corporate Office
ND Seed
Peer
Layer 2-3
ND Seed
Peer
Layer 2-3
Branch Office 1
WAN Link
ND Seed
Peer
Layer 2-3
Branch Office 2
ND Seed
Peer
Sales Office A
ND Seed
Peer
Sales Office B
ND Seed
Peer
Sales Office C

In a Network Domain, one or more WX switches acts as a seed device. A Network Domain seed stores information about all of the VLANs on the Network Domain members. The Network Domain seeds share this information among themselves, so that every seed has an identical database. In the example above, one WX switch at each site is a Network Domain seed.

Each Network Domain member maintains a TCP connection to one of the seeds. When a Network Domain member needs information about a VLAN in a remote Mobility Domain, it consults the Network Domain seed to which it is connected. If the seed has information about the remote VLAN, it responds with the IP address of a WX switch where the VLAN exists. A VLAN tunnel is then created between the WX switch and the remote WX switch.

Figure 5 illustrates how user Bob, who is based at Sales Office C gets connectivity and is placed in a VLAN when he visits the Corporate Office.

Figure 5 How a user connects to a remote VLAN in a Network Domain


①
User Bob connects to WX Switch at Corporate Office
Corporate Office
②
Switch queries ND Seed about VLAN Red
ND Seed Peer
③
ND Seed replies pointing to Switch at Sales Office
Layer 2-3
3com
Bob
⑤
User Bob is connected on VLAN Red
ND Seed Peer
Layer 2-3
Branch Office 1
WAN Link
ND Seed Peer
Layer 2-3
Branch Office 2
④
Tunnel is created between Switch at Corporate Office and Switch at Sales Office
ND Seed Peer
ND Seed Peer
ND Seed Peer
VLAN Red Configured
Sales Office A
Sales Office B
Sales Office C

In this example, Bob establishes connectivity as follows:

1. Bob connects to the wireless network at the Corporate Office. The WX switch contacts the local Mobility Domain seed and finds that the VLAN that Bob is configured to be on, VLAN Red, does not exist in the Corporate Office Mobility Domain.
2. Unable to find VLAN Red in the local Mobility Domain, the WX switch then contacts the local Network Domain seed. The Network Domain seed contains a database of all the VLANs configured on all the members of the Network Domain. (The Network Domain seed may or may not be the same WX switch as the Mobility Domain seed.)
3. The Network Domain seed looks in its database and finds that VLAN Red exists in the Mobility Domain at Sales Office C. The Network Domain seed then responds with the IP address of the remote WX switch where VLAN Red is configured.

4 A VLAN tunnel is created between the WX switch at the Corporate Office and the WX switch at Sales Office C.

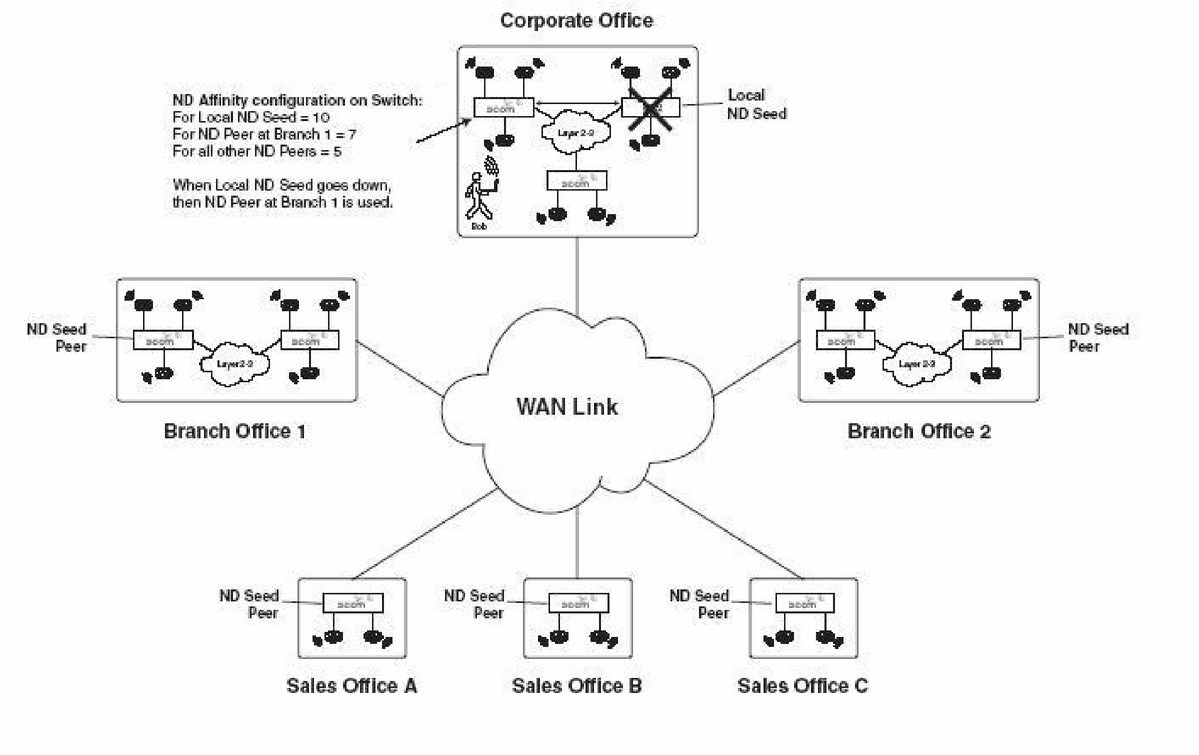
5 Bob establishes connectivity on the network at the corporate office and is placed in VLAN Red.

Network Domain Seed Affinity

When there are multiple Network Domain seeds in an installation, a Network Domain member connects to the seed with which it has the highest configured *affinity*. If that seed is unavailable, the Network Domain member connects to the seed with which it has the next-highest affinity.

Figure 6 illustrates how a WX switch connects to a Network Domain seed based on its configured affinity for the seed.

Figure 6 Configuring a WX Switch's affinity for a Network Domain seed



ND Affinity configuration on Switch:
For Local ND Seed = 10
For ND Peer at Branch 1 = 7
For all other ND Peers = 5

When Local ND Seed goes down, then ND Peer at Branch 1 is used.

Corporate Office
Local ND Seed
3com
Layer 2-3
Bob
ND Seed Peer
Branch Office 1
ND Seed Peer
Branch Office 2
WAN Link
ND Seed Peer
Sales Office A
ND Seed Peer
Sales Office B
ND Seed Peer
Sales Office C

In the previous example, a WX switch in the Mobility Domain at the corporate office is configured as a member of a Network Domain that has a local seed, as well as seeds at the two branch offices and the three sales offices. The WX switch has an affinity value of 10 (highest) for the local seed, and an affinity value of 7 for the seed at Branch Office 1. The WX switch has an affinity of 5 (the default) for the other seeds in the Network Domain.

In the event that the local Network Domain seed becomes unavailable, the WX switch then attempts to connect to the seed at Branch Office 1, its next-highest-affinity seed. Once connected to this seed, the WX switch then periodically attempts to connect to the local seed. When the WX switch is able to connect to the local seed again, it drops the connection to the seed at Branch Office 1.

When you configure a WX switch to be a member of a Network Domain, you specify the seed(s) to which it can connect. As part of this configuration, you can also specify the affinity the WX switch has for each seed.

Configuring a Network Domain

To configure a Network Domain:

1. Designate one or more Network Domain seed WX switches. (See "Configuring Network Domain Seeds" on page 169.)
2. Specify seed peers in the Network Domain. (See "Specifying Network Domain Seed Peers" on page 170.)
3. Configure WX switches to be part of the Network Domain. (See "Configuring Network Domain Members" on page 171.)

You can view the status of a Network Domain, clear members, and clear all Network Domain configuration from a WX switch.

Configuring Network Domain Seeds

In a Network Domain, a member WX switch consults a seed WX switch to determine a user's VLAN membership in a remote Mobility Domain.

Use the following command to set the current WX switch as a seed device within a specified Network Domain:

```
set network-domain mode seed domain-name net-domain-name
```

For example, the following command sets the current WX switch as a seed with the Network Domain *California*:

```
WX1200# set network-domain mode seed domain-name California
success: change accepted.
```

If the seed in a Network Domain is also intended to be a *member* of the Network Domain, you must enter the following command on the seed, with the specified IP address pointing to the seed itself.

```
set network-domain mode member seed-ip ip-addr [affinity num]
```

For example, the following command sets the current WX switch as a member of a Network Domain where the WX switch with IP address 192.168.9.254 is a seed:

```
WX1200# set network-domain mode member seed-ip 192.168.9.254
success: change accepted.
```

You can configure multiple seeds in a Network Domain. When multiple Network Domain seeds are configured, a member consults the seed with which it has the highest configured affinity.

If you are configuring multiple seeds in the same Network Domain (for example, a seed on each physical site in the Network Domain), you must establish a peer relationship among the seeds. See the following section.

Specifying Network Domain Seed Peers

When multiple WX switches are configured as seed devices in a Network Domain, they establish a peer relationship to share information about the VLANs configured on the member devices, so that all of the Network Domain seed peers have the same database of VLAN information. Sharing information in this way provides redundancy in case one of the seed peers becomes unavailable.

Use the following command on a Network Domain seed to specify another seed as a peer:

```
set network-domain peer ip-addr
```

You enter this command on all of the seed devices in the Network Domain, specifying each seed to every other seed, so that all of the Network Domain seeds are aware of each other.

For example, the following command sets the current WX switch as a peer of the Network Domain seed with IP address 192.168.9.254:

```
WX1200# set network-domain peer 192.168.9.254
success: change accepted.
```

This command is valid on Network Domain seeds only.

Configuring Network Domain Members

In a Network Domain, at least one seed device must be aware of each member device. The seed maintains an active TCP connection with the member. To configure a WX switch as a member of a Network Domain, you specify one or more Network Domain seeds for it to use.

If you specify multiple Network Domain seeds, you can also specify the affinity the WX switch has for each seed. The Network Domain member initially attempts to connect to the seed with which it has the highest affinity. If that seed is unavailable, then the WX switch attempts to connect to the seed with which it has the next-highest affinity. If the member connects to a seed with which it does not have the highest configured affinity, then it periodically attempts to connect to its highest-affinity seed. When the WX switch reconnects to the highest-affinity seed, its communication with the next-highest-affinity seed stops.

Use the following command to set the current WX switch as a member of a Network Domain where a specified WX switch is a seed:

```
set network-domain mode member seed-ip ip-addr [affinity num]
```

You can enter this command multiple times on a WX switch, specifying different Network Domain seeds with different affinity values. The affinity value can range from 1 – 10, with 10 being the highest affinity. The default affinity value is 5.

If the Network Domain seed is also intended to be a ***member*** *of the Network Domain, you must also enter this command on the Network Domain seed itself.*

For example, the following command sets the current WX switch as a member of a Network Domain where the WX switch with IP address 192.168.9.254 is a seed:

```
WX1200# set network-domain mode member seed-ip 192.168.9.254
success: change accepted.
```

To specify 10.8.107.1 as an additional Network Domain seed for the WX switch to connect to if the 192.168.9.254 seed is unavailable, enter the following command:

```
WX1200# set network-domain mode member seed-ip 10.8.107.1
affinity 2
success: change accepted.
```

Displaying Network Domain Information

To view the status of Network Domains configured on the WX switch, use the **display network-domain** command. The output of the command differs based on whether the WX switch is a member of a Network Domain or a Network Domain seed.

For example, a WXswitch that is a Network Domain member only, output such as the following is displayed:

```
WX4400# display network-domain

Member Network Domain name: California
Member              State               Mode
---------------     -------------       ------
10.67.1.201         UP                    MEMBER
10.67.1.200         UP                    SEED
```

On a WX switch that is a Network Domain seed, information is displayed about the Network Domain seeds with which the WX switch has a peer relationship, as well as the Network Domains of which the WX switch is a member. For example:

```
WX4400# display network-domain

Network Domain name: California
Peer                State
---------------     -------------
10.67.1.200         UP

Member              State               Mode
---------------     -------------       ------
10.67.1.201         UP                  MEMBER
```

(For more information about this command and the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Clearing Network Domain Configuration from a WX Switch

You can clear all Network Domain configuration from a WX switch, regardless of whether the WX switch is a seed or a member of a Network Domain. You may want to do this in order to change a WX switch from one Network Domain to another, or to remove a WX switch entirely from a Network Domain.

To clear the Network Domain configuration from the WX switch, type the following command:

```
clear network-domain
```

This command has no effect if the WX switch is not configured as part of a Network Domain.

Clearing a Network Domain Seed from a WX Switch

You can remove individual Network Domain seeds from a WX switch's configuration. To remove a specific Network Domain seed, type the following command:

```
clear network-domain seed-ip ip-addr
```

When you enter this command, the Network Domain TCP connections between the WX switch and the specified Network Domain seed are closed.

Clearing a Network Domain Peer from a Network Domain Seed

On a WX switch configured as a Network Domain seed, you can clear the configuration of individual Network Domain peers. To remove a specific Network Domain peer from a Network Domain seed, type the following command:

```
clear network-domain peer ip-addr
```

This command has no effect if the WX switch is not configured as a Network Domain seed.

Clearing Network Domain Seed or Member Configuration from a WX Switch

You can remove the Network Domain seed or member configuration from the WX switch. To do this, enter the following command:

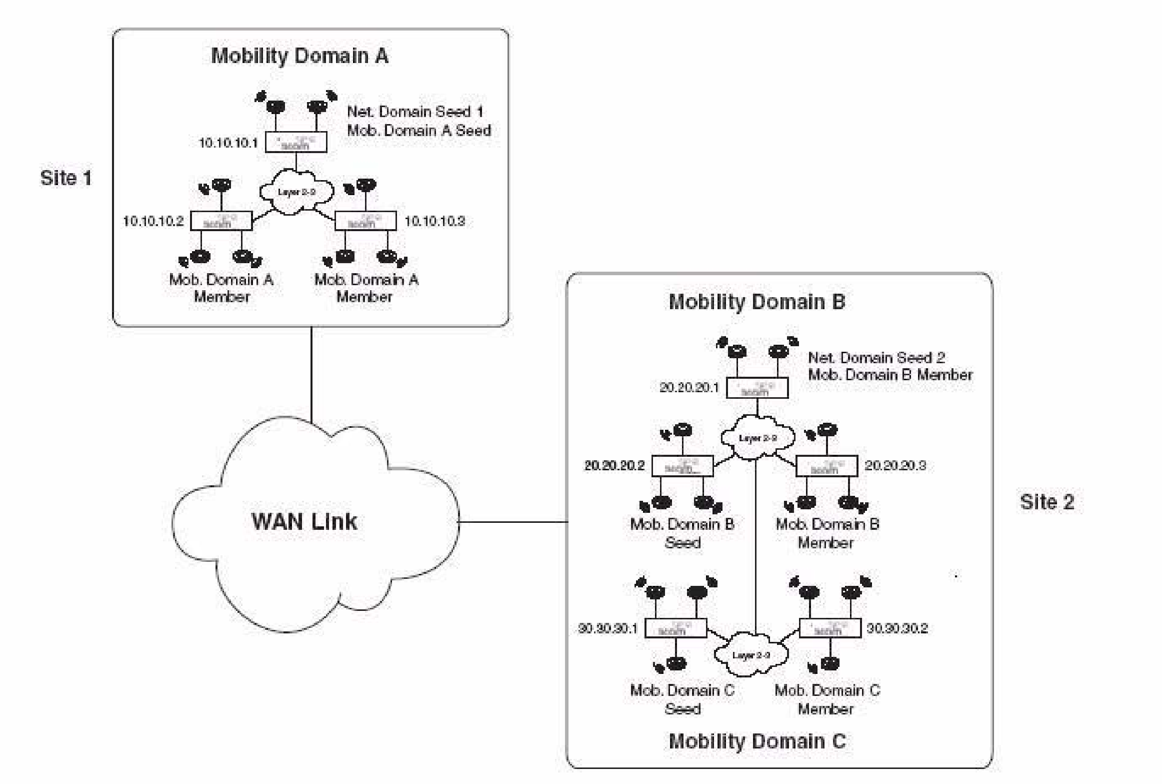
```
clear network-domain mode {seed | member}
```

Use the **seed** parameter to clear Network Domain seed configuration from the WX switch. Use the **member** parameter to clear Network Domain member configuration from the WX switch.

Network Domain Scenario

The following scenario illustrates how to create a Network Domain named *globaldom* consisting of three Mobility Domains at two geographically separated sites. Figure 7 below illustrates this scenario.

Figure 7 Network Domain Scenario


Mobility Domain A
Net. Domain Seed 1
Mob. Domain A Seed
10.10.10.1
Site 1
Layer 2-3
10.10.10.2
10.10.10.3
Mob. Domain A Member
Mob. Domain A Member
Mobility Domain B
Net. Domain Seed 2
Mob. Domain B Member
20.20.20.1
Layer 2-3
20.20.20.2
20.20.20.3
WAN Link
Site 2
Mob. Domain B Seed
Mob. Domain B Member
30.30.30.1
30.30.30.2
Layer 2-3
Mob. Domain C Seed
Mob. Domain C Member
Mobility Domain C

In this scenario, there are three Mobility Domains: A, B, and C. Mobility Domain A is located at Site 1, and Mobility Domains B and C are located at Site 2. There are two Network Domain seeds, one at each site, that share information about the VLANs in the three Mobility Domains. The Network Domain seed at Site 1 is also the seed for Mobility Domain A. The Network Domain seed at Site 2 is used by both Mobility Domains B and C. At least one Network Domain seed is aware of each WX switch in the installation and maintains an active TCP connection with it.

The following is the Network Domain configuration for this scenario:

1. Make the WX switch with IP address 10.10.10.1 a seed of a Network Domain called *globaldom* and establish a peer relationship with the WX switch with IP address 20.20.20.1. Type the following commands:

```
WX1200# set network-domain mode seed domain-name globaldom
success: change accepted.
WX1200# set network-domain peer 20.20.20.1
success: change accepted.
```

2. Make the WX switch with IP address 20.20.20.1 a seed of a Network Domain called *globaldom* and establish a peer relationship with the WX switch with IP address 10.10.10.1. Type the following commands:

```
WX1200# set network-domain mode seed domain-name globaldom
success: change accepted.
WX1200# set network-domain peer 10.10.10.1
success: change accepted.
```

3. Make the three WX switches in Mobility Domain A members of the Network Domain, specifying WX switch 10.10.10.1 as the their Network Domain seed. Type the following command on all three WX switches:

```
WX1200# set mobility-domain mode member seed-ip 10.10.10.1
success: change accepted.
```

4. Make the WX switches in Mobility Domains B and C members the Network Domain, specifying WX switch 20.20.20.1 as the their Network Domain seed. Type the following command on all of the WX switches in both Mobility Domains:

```
WX1200# set mobility-domain mode member seed-ip 20.20.20.1
success: change accepted.
```

5. Display the Network Domain status. Type the following command on the WX switch with IP address 10.10.10.1:

```
WX1200# display network-domain
Network Domain name: globaldom
Peer                State
---------------     -------------
20.20.20.1          UP

Member              State              Mode
---------------     -------------      ------
---------------
10.10.10.1          UP                   SEED
10.10.10.2          UP                 MEMBER
10.10.10.3          UP                 MEMBER
```

```
20.20.20.1          UP                  SEED
20.20.20.2          UP                MEMBER
20.20.20.3          UP                MEMBER
30.30.30.1          UP                MEMBER
30.30.30.2          UP                MEMBER

Member Network Domain name: globaldom
Member              State             Mode
---------------     -------------     ------
---------------
10.10.10.1          UP                  SEED
10.10.10.2          UP                MEMBER
10.10.10.3          UP                MEMBER
20.20.20.1          UP                  SEED
20.20.20.2          UP                MEMBER
20.20.20.3          UP                MEMBER
30.30.30.1          UP                MEMBER
30.30.30.2          UP                MEMBER
```

10 CONFIGURING MAP ACCESS POINTS

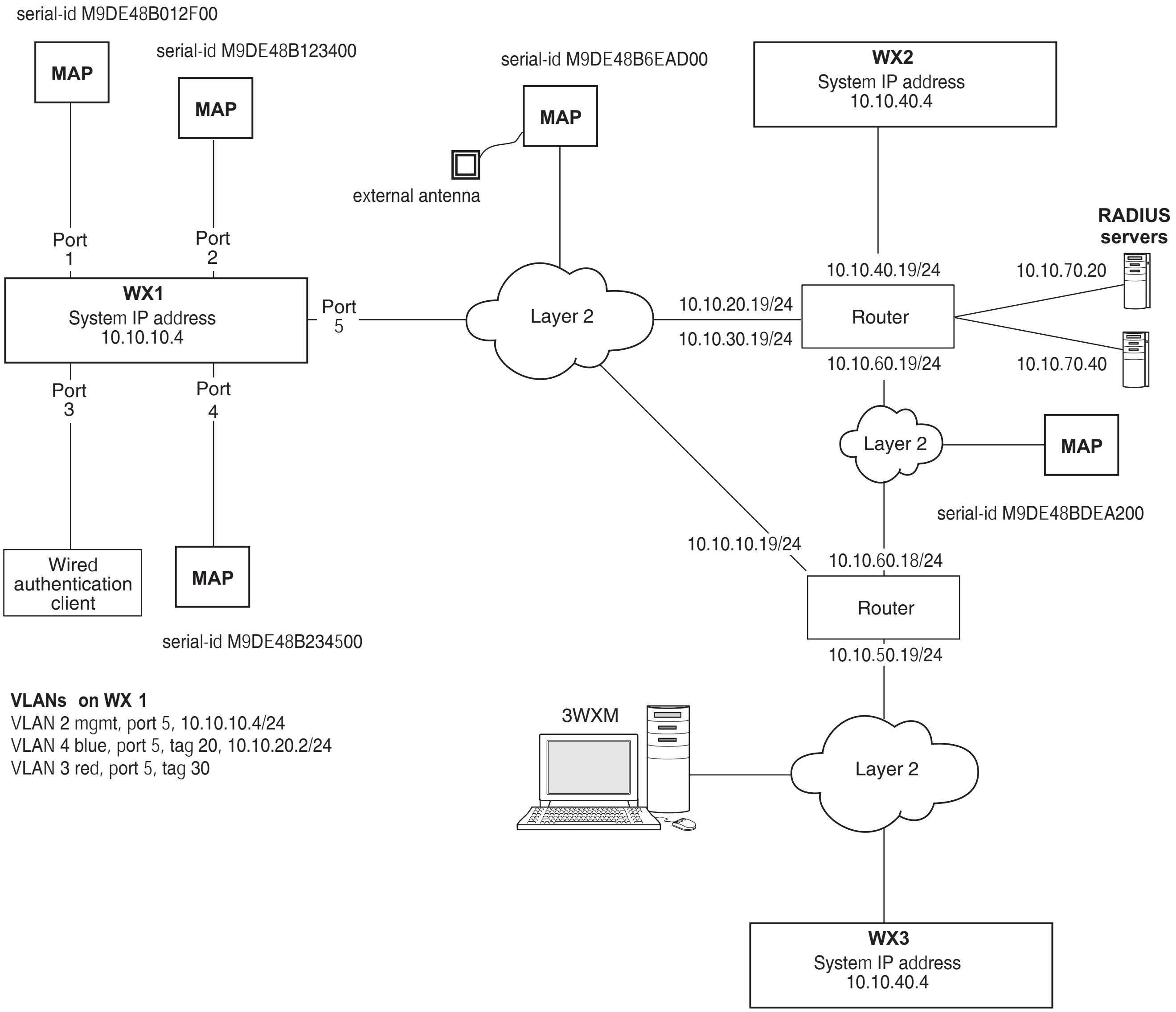
MAPs contain radios that provide networking between your wired network and IEEE 802.11 wireless users. A MAP connects to the wired network through a 10/100 Ethernet link and connects to wireless users through radio signals.

MAP Overview

Figure 8 shows an example of a 3Com network containing MAPs and WX switches. A MAP can be directly connected to a WX switch port or indirectly connected to a WX switch through a Layer 2 or IPv4 Layer 3 network. For redundancy, a MAP can have one of the following combinations of multiple connections:

- Two direct connections to a single WX or two WX switches
- Up to four indirect connections to WX switches through intermediate Layer 2 or Layer 3 networks
- One direct connection to a WX and up to three indirect connections to WX switches through intermediate Layer 2 or Layer 3 networks

Figure 8 Example 3Com Network


serial-id M9DE48B012F00
MAP
serial-id M9DE48B123400
MAP
serial-id M9DE48B6EAD00
MAP
external antenna
WX2
System IP address
10.10.40.4
Port 1
Port 2
WX1
System IP address
10.10.10.4
Port 5
Layer 2
10.10.20.19/24
10.10.30.19/24
RADIUS servers
10.10.40.19/24
10.10.70.20
Router
10.10.60.19/24
10.10.70.40
Port 3
Port 4
Layer 2
MAP
serial-id M9DE48BDEA200
10.10.10.19/24
10.10.60.18/24
Wired authentication client
MAP
Router
serial-id M9DE48B234500
10.10.50.19/24
VLANs on WX 1
VLAN 2 mgmt, port 5, 10.10.10.4/24
VLAN 4 blue, port 5, tag 20, 10.10.20.2/24
VLAN 3 red, port 5, tag 30
3WXM
Layer 2
WX3
System IP address
10.10.40.4

To configure MAPs, perform the following tasks, in this order:

- Specify the country of operation.
- Configure MAP access ports, Distributed AP connections, and dual homing.
- If required, configure radio-specific parameters, which include the channel number, transmit power, and external antenna type.

You do not need to set channels and power if you use RF Auto-Tuning to set these values. You do not need to specify an external antenna type unless a radio uses an external antenna.

However, if you do install an external antenna, you must ensure that the external antenna model parameter you specify exactly matches the external antenna that is attached to the MAP's external antenna port, in order to meet regulatory requirements.

- Configure SSID and encryption settings in a service profile.
- Map the service profile to a radio profile, assign the radio profile to radios, and enable the radios.

Country of Operation

Before you can configure MAPs and radio parameters, you must specify the country in which you plan to operate the radios. Since each country has different regulatory environments, the country code determines the transmit power levels and channels you can configure on the radios. MSS ensures that the values you can configure are valid for the country you specify.

Directly Connected MAPs and Distributed MAPs

To configure the WX switch to support a MAP, you must first determine how the MAP connects to the switch. There are two types of MAP to WX connections: direct and distributed.

- In direct connection, a MAP connects to a 10/100 port on a WX1200 or WXR100. The WX port is then configured specifically for a direct attachment to the MAP. There is no intermediate networking equipment between the WX and MAP and only one MAP is connected to the WX port. The WX 10/100 port provides PoE to the MAP. The WX also forwards data only to and from the configured MAP on that port. The port numbers on the WX configured for directly attached MAPs reference a particular MAP.
- A MAP that is not directly connected to a WX is considered a Distributed MAP. There may be intermediate Layer 2 switches or Layer 3 IP routers between the WX and MAP. The WX may communicate to the Distributed MAP through any network port. (A network port is any port connecting the switch to other networking devices, such as switches and routers, and it can also be configured for 802.1Q VLAN tagging.) The WX contains a configuration for a Distributed MAP based on the MAP serial number.

Similar to ports configured for directly connected MAPs, distributed MAP configurations are numbered and can reference a particular MAP. These numbered configurations do not, however, reference any physical port.

Distributed MAP Network Requirements

Because Distributed MAPs are not directly attached to a WX, they require additional support from the network in order to function. Information on the booting and operation sequence for Distributed MAPs is covered in the section "Boot Process for Distributed MAPs" on page 189.

- **Power** — PoE must be provided on one of the Ethernet connections to the MAP. Be sure to use a PoE injection device that has been tested by 3Com. (Contact 3Com for information.)
- **DHCP** — By default, a Distributed MAP uses TCP/IP for communication, and relies on DHCP to obtain IP parameters. Therefore, DHCP services must be available on the subnet that the MAP is connected to. DHCP must provide the following parameters to the MAP:
    - IP address
    - Domain name
    - DNS server address
    - Default router address
- **Static IP configuration**—If DHCP is not available in the network, a Distributed MAP can be configured with static IP information that specifies its IP address, as well as the WX switch it uses as its boot device.
- **DNS** — If the intermediate network between the WX switch and Distributed MAP includes one or more IP routers, create a 3COMWX.*mynetwork*.com entry on the DNS server. The entry needs to map this name to the system IP address of the switch. If the subnet contains more than one WX in the same Mobility Domain, you can use the system IP address of any of the WX switches. (For redundancy, you can create more than one DNS entry, and map each entry to a different WX switch in the subnet.)

The DNS entry allows the MAP to communicate with a WX that is not on the MAP subnet. If the MAP is unable to locate a WX on the subnet, the MAP sends DNS requests to 3COMWX, where the DNS suffix for *mynetwork*.com is learned through DHCP.

If only *3COMWX* is defined in DNS, the MAP contacts the WX with an IP address returned for 3COMWX.

Distributed MAPs and STP

A Distributed MAP is a leaf device. You do not need to enable STP on the port that is directly connected to the MAP.

If Spanning Tree Protocol (STP) is enabled on the port that is directly connected to a Distributed MAP, you might need to change the STP configuration on the port, to allow the MAP to boot.

STP on a port directly connected to a Distributed MAP can prevent the MAP from booting.

As part of the boot process, a MAP disables and reenables the link on the port over which the MAP is attempting to boot. If STP is enabled on the device that is directly connected to the port, the link state change can cause the port on the other device to leave the forwarding state and stop forwarding traffic. The port remains unable to forward traffic for the duration of the STP forwarding delay.

A MAP waits 30 seconds to receive a reply to its DHCP Discover message, then tries to boot using the other MAP port. If the boot attempt fails on the other port also, the MAP then reattempts to boot on the first port. The process continues until a boot attempt is successful. If STP prevents the other device's port from forwarding traffic during each boot attempt, the MAP repeatedly disables and reenables the link, causing STP to repeatedly stop the other device's port from forwarding traffic. As a result, the boot attempt is never successful.

To allow a MAP to boot over a link that has STP enabled, do one of the following on the other device:

- Disable STP on the port of the other device.
- Enable the port fast convergence feature, if supported, on the other device port. (On some vendors' devices, this feature is called *PortFast*.)
- If the other device is running Rapid Spanning Tree or Multiple Spanning Tree, set the port into edge port mode.

Distributed MAPs and DHCP Option 43

The option 43 field in a DHCP Offer message can provide a simple and effective way for MAPs to find WX switches across an intermediate Layer 3 network, and is especially useful in networks that are geographically distributed or have a flat domain name space. You can use the DHCP option 43 field to provide a list of WX IP addresses, without the need to configure DNS servers.

To use DHCP option 43, configure the option to contain a comma-separated list of WX IP addresses or fully qualified hostnames (host name and domain name; for example, *host.domain.com*), in the following format:

```
ip:ip-addr1,ip-addr2,...
```

or

```
host:hostname1,hostname2,...
```

You can use an IP address list or a hostname list, but not both. If the list contains both types of values, the MAP does not attempt to use the list.

The **ip** and **host** keywords can be in lowercase, uppercase (**IP** or **HOST**), or mixed case (example: **Ip**, **Host**, and so on.) You can use spaces after the colon or commas, but spaces are not supported within IP addresses or hostnames. Leading zeroes are supported in IP addresses. For example, 100.130.001.1 is valid.

Valid characters in hostnames are uppercase and lowercase letters, numbers, periods (**.**), and hyphens (**-**). Other characters are not supported.

If you use the **host** option, you must configure the network's DNS server with address records that map the hostnames in the list to the WX IP addresses.

After receiving a DHCP Offer containing a valid string for option 43, a Distributed MAP sends a unicast Find WX message to each WX switch in the list. See "How a Distributed MAP Contacts a WX Switch (DHCP-Obtained Address)" on page 190 for a description of this process.

No configuration is required on the WX.

MAP Parameters

Table 9 summarizes parameters that apply to individual MAPs, including dual-homing parameters. (For information about parameters for individual radios, see "Configuring a Radio Profile" on page 240 and "Configuring Radio-Specific Parameters" on page 246.)

Table 9 Global MAP Parameters

Parameter	Default value	Description
name	Based on the port or Distributed MAP connection number. For example: ▪ MAP01 ▪ DAP01	MAP name.
bias	**high**	Setting a MAP's bias on a WX switch to high causes the switch to be preferred over switches with low bias, for booting and managing the MAP. **Note:** Bias applies only to WX switches that are indirectly attached to the MAP through an intermediate Layer 2 or Layer 3 network. A MAP always attempts to boot on MAP port 1 first, and if a WX switch is directly attached on MAP port 1, the MAP boots from it regardless of the bias settings.
group	None	Named set of MAPs. MSS load-balances user sessions among the access points in the group.
upgrade-firmware	**enable**	Automatic upgrade of boot firmware.
blink	**disable**	LED blink mode — blinking 11a LED (AP2750) or health and radio LEDs (MAP-*xxx*) make the MAP visually easy to identify.

Resiliency and Dual-Homing Options for MAPs

MAPs can support a wide variety of resiliency options. Redundancy for data link connections and for WX services can be provided to the MAP.

- PoE redundancy—On MAP models that have two Ethernet ports, you can provide PoE redundancy by connecting both ports to PoE sources. PoE can come from a directly connected WX or a PoE injector. Dual-homing support for PoE is automatically enabled when you connect both MAP Ethernet ports.
- Data link redundancy—You can provide data link redundancy by connecting both Ethernet ports directly to one WX, two WX switches, an intermediate Ethernet switch, or a combination of WX and Ethernet switch. If an intermediate Ethernet connection is used, you also need a Distributed MAP configuration on a WX somewhere in the network. Dual-homing support for data link redundancy is automatically enabled when you connect both MAP Ethernet ports.
- WX redundancy—You can provide redundancy of WX services by dual-homing the MAP to two directly connected WX switches; or by configuring a Distributed MAP configuration either on two or more indirectly connected WX switches, or on a combination of a directly connected WX and one or more indirectly connected WX switches. To provide WX redundancy on a MAP model that has only one MAP port, configure a Distributed MAP connection on two or more indirectly connected WX switches.

Bias On a WX, configurations for MAPs have a bias (low or high) associated with them. The default is high. A WX with high bias for a MAP is preferred over a WX with low bias for the MAP

If more than one WX has high bias, or the bias for all connections is the same, the WX with the greatest capacity to add more active MAPs is preferred. For example, if one WX has 50 active MAPs while another WX has 60 active MAPs, and both WX switches are capable of managing 80 active MAPs, the new MAP uses the WX that has only 50 active MAPs.

Bias applies only to WX *switches that are indirectly attached to the MAP through an intermediate Layer 2 or Layer 3 network. A MAP always attempts to boot on MAP port 1 first, and if a WX switch is directly attached on MAP port 1, the MAP boots from it regardless of the bias settings.*

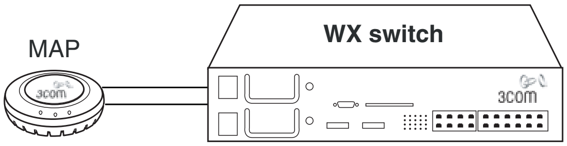
(To set the bias for a MAP configuration, see “Changing Bias” on page 227.)

Dual-Homed Configuration Examples

The following sections show examples of dual-homed configurations. You can use any of these configurations to dual home a MAP model that has two Ethernet ports. MAP models with one Ethernet port support only the dual-homing configuration in "Dual-Homed Distributed Connections to WX Switches on One MAP Port" on page 188.

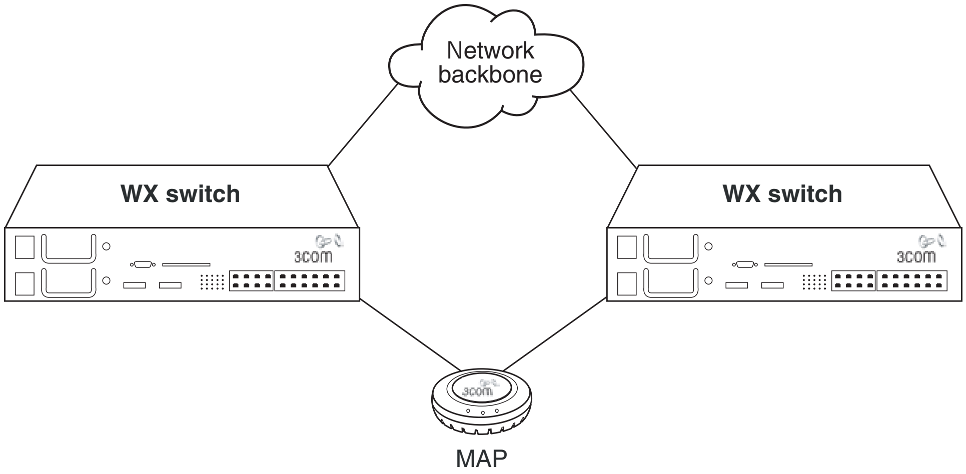
Dual-Homed Direct Connections to a Single WX Figure 9 shows an example of a dual-homed direct connection to one WX switch. In this configuration, if the MAP's active data link with the WX switch fails, the MAP detects the link failure and restarts using the other link on the same switch.

Figure 9 Dual-Homed Direct Connections to a Single WX



Dual-Homed Direct Connections to Two WX Switches Figure 10 shows an example of a dual-homed direct connection to two separate WX switches. In this configuration, if the active data link fails, the MAP detects the link failure and restarts using a link to the other switch.

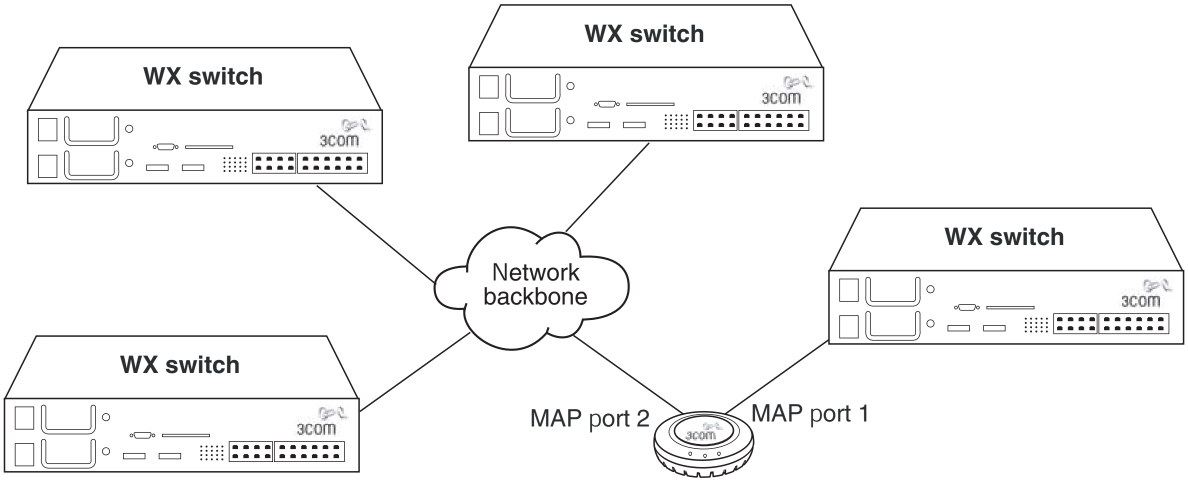
Figure 10 Dual-homed Direct Connections to Two WX Switches



Dual-Homed Direct and Distributed Connections to WX Switches

Figure 11 shows an example of a dual-homed configuration in which one MAP connection is direct and the other is distributed over the network.

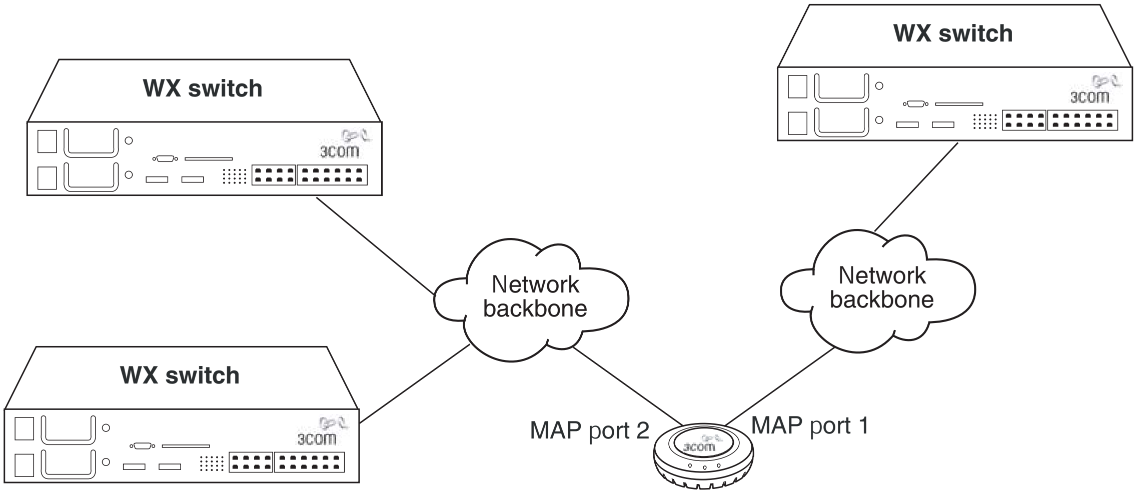
Figure 11 Dual-Homed Direct and Distributed Connections to WX Switches


WX switch
WX switch
WX switch
WX switch
Network backbone
MAP port 2
MAP port 1

In this example, the MAP port 1 is directly connected to a WX. The MAP always attempts to boot first from the directly connected WX. The MAP attempts to boot using MAP port 2 only if the boot attempt on port 1 fails. If the active data link fails, the WX reboots using the other link.

Dual-Homed Distributed Connections to WX Switches on Both MAP Ports Figure 12 shows an example of a dual-homed configuration in which both MAP connections are distributed over the network.

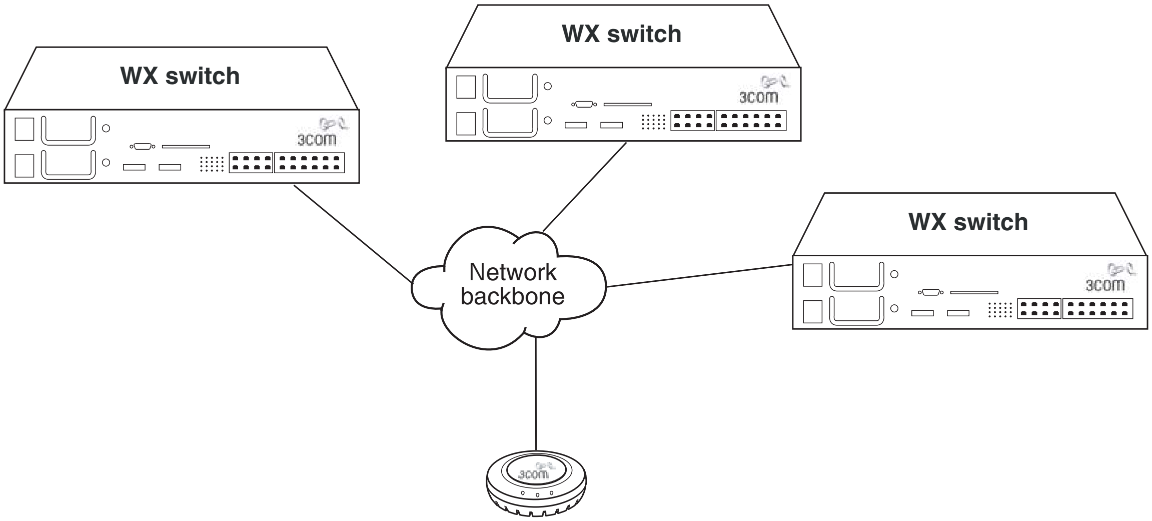
Figure 12 Dual-homed Distributed Connections to WX Switches on Both MAP Ports


WX switch
WX switch
WX switch
Network backbone
Network backbone
MAP port 2
MAP port 1

In this configuration, the MAP first attempts to boot on its port 1. If more than one WX has high bias or if all WX switches have the same bias, the MAP uses the WX that has the greatest capacity for new active MAP connections.

Dual-Homed Distributed Connections to WX Switches on One MAP Port Figure 13 shows an example of a MAP with a single physical link to a network containing three WX switches.

Figure 13 Single-homed Connection to Multiple WX Switches on One MAP Port



In this configuration, the MAP sends a boot request on its connected port. WX switches in the same subnet respond to the MAP. WX switches with high bias for the MAP respond immediately, whereas WX switches with low bias for the MAP respond after a brief delay.

If the switches are in another subnet, the MAP uses DNS to locate one of the switches, and asks the switch to send the IP address of the best WX to use, based on the bias settings on each switch and the capacity of each switch to add new active MAP connections. The MAP then requests its image and configuration files from the best WX.

Boot Process for Distributed MAPs

When a distributed MAP boots on the network, it uses the process described in this section. Note that this process applies only to distributed MAPs; it does not apply to a directly connected MAP. The boot process for a directly connected MAP occurs strictly between the MAP and WX switch and makes no use of the network's DHCP or DNS services.

The boot process for a distributed MAP consists of the following steps:

1. Establishing connectivity on the network
2. Contacting a WX switch
3. Loading and activating an operational image
4. Obtaining configuration information from the WX switch

These steps are described in more detail in the following sections.

Establishing Connectivity on the Network

When a MAP is first powered on, its bootloader obtains an IP address for the MAP. The IP address is either obtained through DHCP (the default) or can be statically configured on the MAP.

How a Distributed MAP Obtains an IP Address through DHCP

By default, a distributed MAP obtains its IP address through DHCP. The MAP brings up the link on the MAP's port 1 and attempts the boot process outlined below.

1. The MAP sends a DHCP Discover message from the MAP's port 1 to the broadcast address.
2. If a DHCP server is present on the subnet or through a router configured to relay DHCP, the server replies with a unicast DHCP Offer message. The Offer message must contain the following parameters:
   - IP address for the MAP
   - Domain name of the network
   - IP address of the network's DNS server
   - IP address of the subnet's default gateway router (gateway)

   Optionally, the DHCP Offer message can also contain a list of WX IP addresses or fully qualified hostnames, in the Option 43 field.

3. The MAP broadcasts a DHCP Request to the DHCP servers, and receives an Ack from a DHCP server. The MAP then configures its network connection with the information contained in the Ack message from that server.

Static IP Address Configuration for Distributed MAPs

In cases where DHCP is not available, you can manually assign IP address information to a Distributed MAP. This information is configured through the CLI.

You can configure the following information for a Distributed MAP:

a IP address, subnet mask, default gateway router, and whether the configured static IP address information is enabled for the MAP.

b The IP address of a suitable WX switch for the MAP to use as a boot device.

c The fully qualified domain name of a WX switch to use as a boot device, and the IP address of a DNS server used to resolve the WX switch's name.

These items are referred to by letter in the description of how the MAP contacts a WX switch in "How a Distributed MAP Contacts a WX Switch (Statically Configured Address)" on page 193. If the MAP does not have static IP address information configured, or its static IP configuration is disabled, then the MAP obtains its IP address through DHCP.

Contacting a WX Switch

After the MAP has an IP address, it attempts to contact a WX switch on the network. The method used for contacting a WX switch depends on whether the MAP's IP address was obtained through DHCP or was configured statically.

How a Distributed MAP Contacts a WX Switch (DHCP-Obtained Address)

1. If the DHCP Offer message contained WX IP addresses or fully qualified hostnames in the Option 43 field, the MAP proceeds as follows:
   - If the DHCP Offer message contained one or more IP addresses in the Option 43 field, the MAP sends a unicast Find WX message to each address. The process skips to step 6.
   - If the DHCP Offer message contained one or more hostnames in the Option 43 field, the MAP sends DNS Requests to the DNS server for the IP addresses of the hosts, then sends a unicast Find WX message to each address. The process skips to step 6.

This method requires DNS address records on the DNS server that map the hostnames to the WX IP addresses.

   - If no WX switches reply, the MAP repeatedly resends the Find WX messages. If no WX switches reply, the process continues with step 3.

2. If no IP addresses or hostnames were specified in the Option 43 field of the DHCP Offer message, the MAP sends a Find WX message to UDP port 5000 on the subnet broadcast address.
   - WX switches in the same IP subnet as the MAP receive the message and respond with a Find WX Reply message.
     - If the MAP is configured as a Distributed MAP on a switch and the connection bias is high, the WX switch immediately sends a Find WX Reply message.
     - If the MAP is configured as a Distributed MAP on a switch but the connection bias is low, that WX switch waits one second, then sends a Find WX Reply message. The delay allows switches with high bias for the MAP to respond first.
     - If a WX switch that receives the Find WX message does not have the Distributed MAP in its configuration but another WX switch in the same Mobility Domain does, the switch waits two seconds, then sends a Find WX Reply message with the IP address of the best switch to use. The determination of best switch is based on the bias settings for the MAP on each switch and on the capacity of each switch to add new active MAP connections.

     The process skips to step 6.
   - If no WX switches reply, the MAP repeatedly resends the Find WX broadcast. If still no WX switches reply, the process continues with step 3.
3. If the MAP is unable to locate a WX on the subnet it is connected to, and is unable to find a WX based on information in the DHCP option 43 field, the MAP sends DNS requests for both *3COM* and *wlan-switch*, where the DNS suffix for *mynetwork.com* is learned through DHCP.

You must configure a DNS address record on your DNS server for the WX IP address. Otherwise, the DNS server cannot provide the WX switch's address to the MAP.

4. The DNS server replies with the system IP address of a WX switch.
   - If only *3COM* is defined in DNS, the MAP sends a unicast Find WX message to the WX switch whose IP address is returned for *3Com*.

- If only *wlan-switch* is defined in DNS, the MAP sends a unicast Find WX message to the WX switch whose IP address is returned for *wlan-switch*.
- If both *3Com* and *wlan-switch* are defined in DNS, the MAP sends a unicast Find WX message to the WX switch whose IP address is returned for *3Com*. The MAP ignores the IP address returned for *wlan-switch*.
- If both *3Com* and *wlan-switch* are defined in DNS, and the MAP is unable to contact the IP address returned for *3Com*, the MAP never contacts the IP address returned for *wlan-switch*. The MAP does not boot.

5 The MAP sends Find WX requests to the WX IP addresses given by the DNS reply. If a WX receives the Find WX Request, the process continues with step 6.

However, if no WX switches reply, the MAP repeatedly retries this method:

- If still no WX switches reply, the MAP begins the process again, starting with the procedure under "How a Distributed MAP Contacts a WX Switch (DHCP-Obtained Address)" on page 190, on the other MAP port.
- If the other MAP port does not have a link or the MAP has only one port, the MAP instead restarts, and begins the process again on the same MAP port.

6 6 The WX that receives the Find WX request determines the best WX for the MAP to use, based on the bias settings for the MAP on each switch. If more than one switch has high bias for the MAP or all switches have the same bias, the WX suggests the switch that has the highest capacity to add new active MAP connections.

7 The WX sends a unicast Find WX Reply message to the MAP containing the system IP address of the best WX switch to use.

8 The MAP sends a unicast message to the suggested WX switch, to request an operational image. If the MAP does not receive a reply after 10 seconds, the MAP reboots and starts the boot process over.

If a MAP does not receive a reply to a DNS request or a request for an operational image after one minute, the MAP starts the boot process over with a new DHCP Discover message, this time from MAP port 2.

How a Distributed MAP Contacts a WX Switch (Statically Configured Address)

When configuring a distributed MAP with static IP information, you can specify the following information:

a IP address, subnet mask, default gateway router, and whether the configured static IP address information is enabled for the MAP.

b The IP address of a suitable WX switch for the MAP to use as a boot device.

c The fully qualified domain name of a WX switch to use as a boot device, and the IP address of a DNS server used to resolve the WX switch's name.

This information is used in the following way when the MAP attempts to contact a WX switch:

1. If Items A and B (but not Item C) are specified, and the WX switch's IP address is part of the local subnet, then the AMP sends an ARP request for its configured static IP address, to ensure that it is not already in use in the network. The MAP then sends a Find WX message to UDP port 5000 at the WX switch's IP address.
   - If the MAP receives a response from that address, it sends a unicast message to the WX switch, to request an operational image.
   - If the MAP does not get a response, then it sends a Find WX message to UDP port 5000 on the subnet broadcast address.
     - If the MAP receives a response to the broadcast Find WX message, then the process continues using the procedure described under "How a Distributed MAP Contacts a WX Switch (DHCP-Obtained Address)" on page 190.
     - If there is no response to the broadcast Find WX message, then the process skips to step 4 on page 191.
   - If the WX switch is not part of the local subnet, then the MAP uses the default gateway router address to contact the WX switch.
2. If Item A, but not Item B is specified, then the MAP uses the specified static IP configuration, and broadcasts a Find WX message to the subnet.
   - If the MAP receives a response to the broadcast Find WX message, then the process continues using the procedure described under "How a Distributed MAP Contacts a WX Switch (DHCP-Obtained Address)" on page 190.

- If there is no response to the broadcast Find WX message, the WX continues broadcasting the Find WX message for a period of time. If still no response is received, then the process skips to step 4 on page 191.

3 If Items A and C are specified, the MAP sends a DNS request to resolve the fully qualified domain name of the WX switch. If the DNS server is not on the local subnet, the MAP uses the default gateway router address to contact the DNS server.

- If there is no response from the DNS server, then the process skips to step 4 on page 191
- If there is a response from the DNS server, then the MAP sends a Find WX message to the WX switch.
    - If a response is received from the WX switch, then the MAP sends a unicast message to the WX switch, to request an operational image.
    - If a response is not received from the WX switch, then the process skips to step 4 on page 191.

4 If the MAP cannot reach the WX switch using the static IP address information, then the MAP attempts to boot using the default boot process; that is, by contacting a DHCP server, as described in "How a Distributed MAP Contacts a WX Switch (DHCP-Obtained Address)" on page 190. If the default MAP boot process does not succeed, then the MAP again attempts to boot using its statically configured IP information. The MAP alternates between the two boot processes until the WX switch is contacted.

If the default MAP boot process is successful, but the DHCP response does not include a DNS server address, then the IP address of the DNS server specified as part of Item C is used.

Loading and Activating an Operational Image

A MAP's operational image is the software that allows it to function on the network as a wireless access point. As part of the MAP boot process, an operational image is loaded into the MAP's RAM and activated. The MAP stores copies of its operational image locally, in its internal flash memory. The MAP can either load the locally stored image, or it can download an operational image from the WX switch to which it has connected.

After the MAP establishes a connection to a WX switch, the MAP's bootloader determines if the WX switch permits the MAP to load a local image or if the image should be downloaded from the WX switch.

The MAP loads its local image only if the WX switch is running MSS Version 5.0 or later, and the WX switch does not have a newer MAP image than the one stored locally on the MAP. If the WX switch is not running MSS Version 5.0 or later, or the WX switch has a newer version of the MAP image than the version in the MAP's local storage, the MAP downloads the operational image from the WX switch.

The bootloader also compares the version of the local image to the version available from the WX switch. If the two versions do not match, the image is downloaded from the WX switch, so that the MAP's local image matches the version from the WX switch.

After an operational image is downloaded from the WX switch, it is copied into the MAP's flash memory. The MAP then reboots, copying the downloaded operational image from its flash memory into RAM.

Obtaining Configuration Information from the WX Switch

Once the MAP loads an operational image, either from local storage or downloaded from a WX switch, the MAP receives configuration information from the WX switch to which it has connected. This information includes commands that activate the radios on the MAP, regulate power levels, assign SSIDs, and so on.

After the MAP receives the configuration information from the WX switch, it is then operational on the network as a wireless access point.

MAP Boot Examples

The following figures show MAP boot examples:

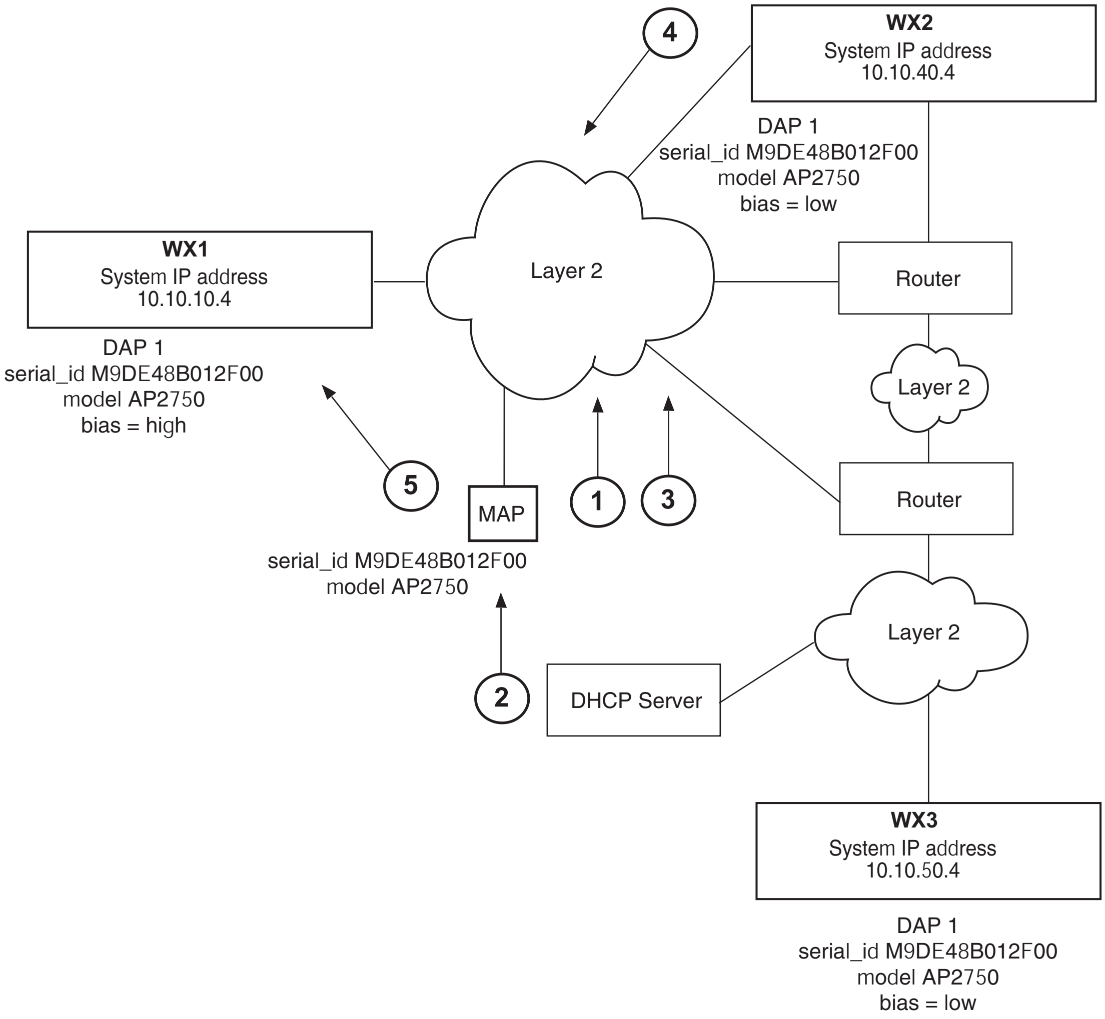
- Figure 14 on page 196 shows an example of the boot process for a MAP connected through a Layer 2 network.

- Figure 15 on page 198 shows an example of the boot process for a MAP connected through a Layer 3 network.
- Figure 16 on page 200 shows an example of the boot process for a dual-homed MAP that has one direct connection to a WX switch and an indirect connection through a Layer 2 network.
- Figure 17 on page 201 shows an example of the boot process for a MAP that has been configured with static IP information.

Example MAP Boot over Layer 2 Network

Figure 14 shows an example of the boot process for a MAP connected through a Layer 2 network. WX1, WX2, and WX3 each have a Distributed MAP configuration for the MAP.

Figure 14 MAP Booting over Layer 2 Network


4
WX2
System IP address
10.10.40.4
DAP 1
serial_id M9DE48B012F00
model AP2750
bias = low
WX1
System IP address
10.10.10.4
DAP 1
serial_id M9DE48B012F00
model AP2750
bias = high
Layer 2
Router
Layer 2
5
MAP
1
3
Router
serial_id M9DE48B012F00
model AP2750
Layer 2
2
DHCP Server
WX3
System IP address
10.10.50.4
DAP 1
serial_id M9DE48B012F00
model AP2750
bias = low

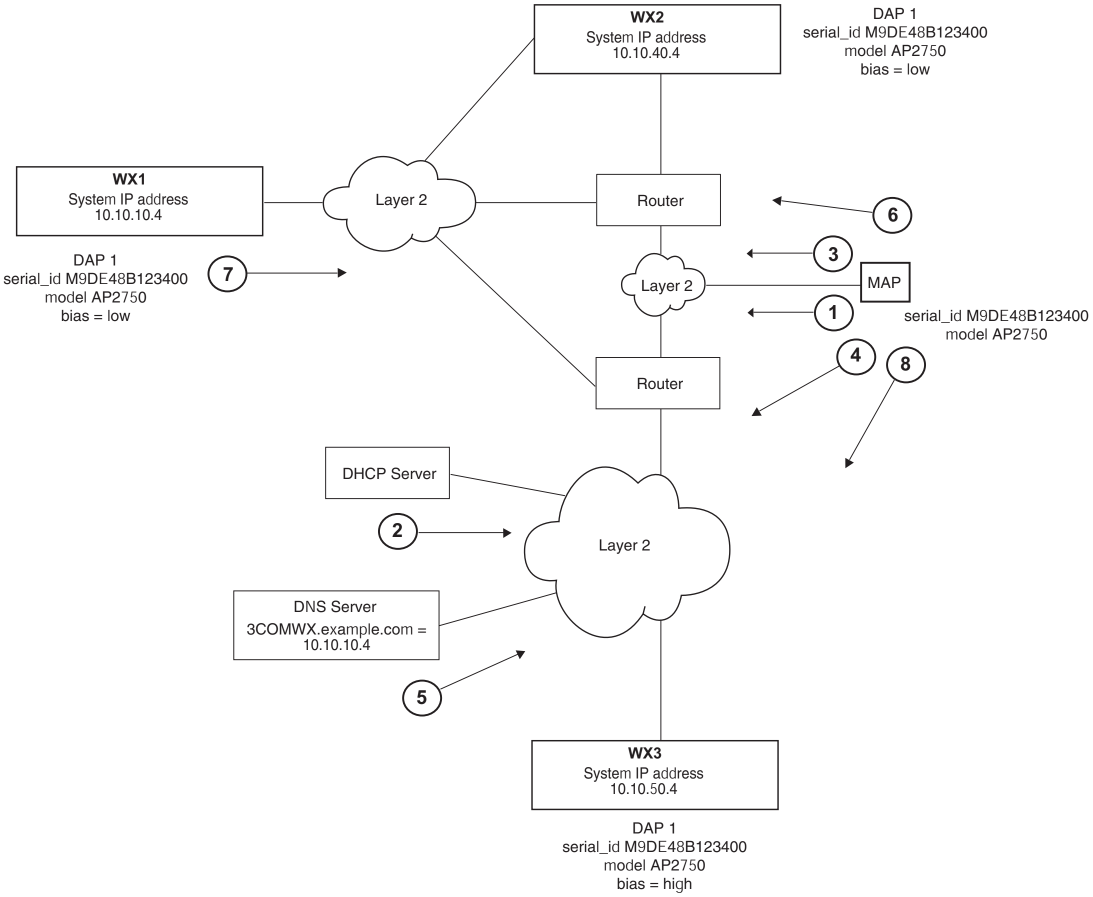
1. The MAP sends a DHCP Discover message from the MAP port 1.
2. DHCP server receives the Discover message (through a relay agent) and replies with a DHCP Offer message containing IP address for the MAP, the router IP address for the MAP IP subnet, the DNS server address, and the domain name. MAP then sends a DHCP Request message to the server and receives an Ack from the server.
3. MAP sends a broadcast Find WX message to IP subnet broadcast address.
4. WX1 and WX3 have high priority for the MAP and reply immediately.
5. The MAP contacts WX1 and determines whether it should use a locally stored operational image or download it from the WX switch.

   WX1 is contacted because it has fewer active MAP connections than WX3. Once the operational image is loaded, the MAP requests configuration information from WX1.

Example MAP Boot over Layer 3 Network

Figure 15 shows an example of the boot process for a MAP connected through a Layer 3 network.

Figure 15 MAP Booting over Layer 3 Network


WX2
System IP address
10.10.40.4
DAP 1
serial_id M9DE48B123400
model AP2750
bias = low
WX1
System IP address
10.10.10.4
DAP 1
serial_id M9DE48B123400
model AP2750
bias = low
Layer 2
Router
6
3
Layer 2
MAP
1
serial_id M9DE48B123400
model AP2750
7
4
8
Router
DHCP Server
2
Layer 2
DNS Server
3COMWX.example.com =
10.10.10.4
5
WX3
System IP address
10.10.50.4
DAP 1
serial_id M9DE48B123400
model AP2750
bias = high

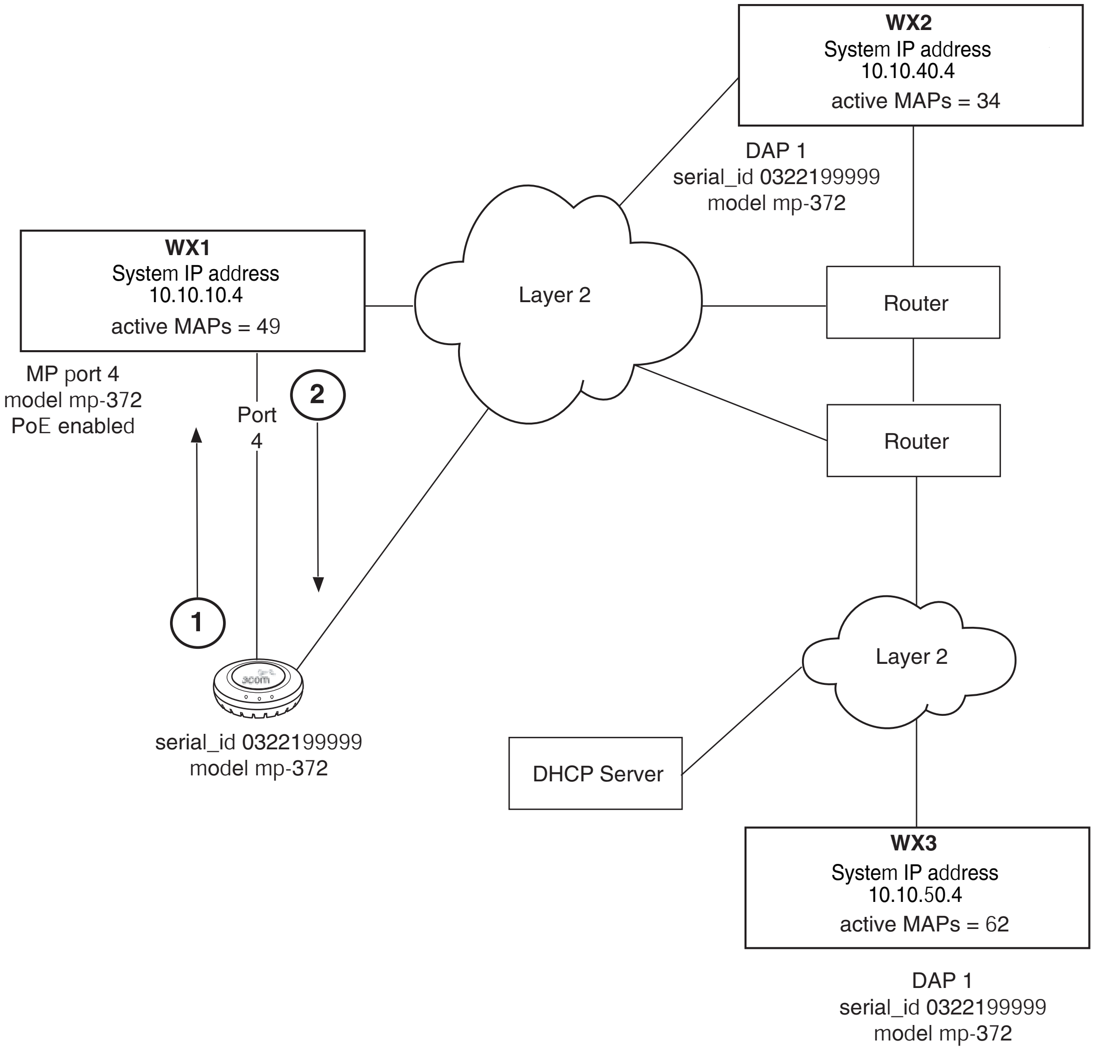
1. The MAP sends DHCP Discover message from the MAP’s port 1.
2. The DHCP server replies with a DHCP Offer message containing an IP address for the MAP, the default router IP address for the MAP’s IP subnet, the DNS server address, and the domain name. MAP then sends a DHCP Request message to the server and receives an Ack from the server.
3. The MAP sends a broadcast Find WX message to the IP subnet broadcast address.
4. When the MAP is unable to locate a WX on the subnet it is connected to, the MAP then sends a DNS request for *3com.example.com* and *wlan.example.com*.

5. The DNS server sends the system IP address of the WX switch mapped to *3com.example.com*. In this example, the address is for WX1.
6. The MAP sends a unicast Find WX message to WX1.
7. WX1 receives the Find WX message and compares the bias settings on each WX for the MAP. More than one WX has a high bias for the MAP, so WX1 selects the WX that has the greatest capacity to add new active MAP connections. In this example, WX1 has more capacity. WX1 sends its own IP address in the Find WX Reply message to the MAP.
8. The MAP contacts WX1 and determines whether it should use a locally stored operational image or download it from the WX switch. Once the operational image is loaded, the MAP requests configuration information from WX1.

Example Boot of Dual-Homed MAP

Figure 16 shows an example of the boot process for a MAP that is dual homed with a direct connection to WX1 and an indirect connection to WX2 and WX3. In this configuration, since the MAP is directly connected to a WX switch, the MAP boots using the directly connected WX switch regardless of the bias set on any of the WX switches configured for the MAP. Only in the event of a physical port failure would the MAP attempt to boot from its port 2.

Figure 16 Dual-Homed MAP Booting


WX2
System IP address
10.10.40.4
active MAPs = 34
DAP 1
serial_id 0322199999
model mp-372
WX1
System IP address
10.10.10.4
active MAPs = 49
Layer 2
Router
Router
MP port 4
model mp-372
PoE enabled
Port
4
2
1
serial_id 0322199999
model mp-372
Layer 2
DHCP Server
WX3
System IP address
10.10.50.4
active MAPs = 62
DAP 1
serial_id 0322199999
model mp-372

1 MAP sends a DHCP Discover message from the MAP’s port 1.

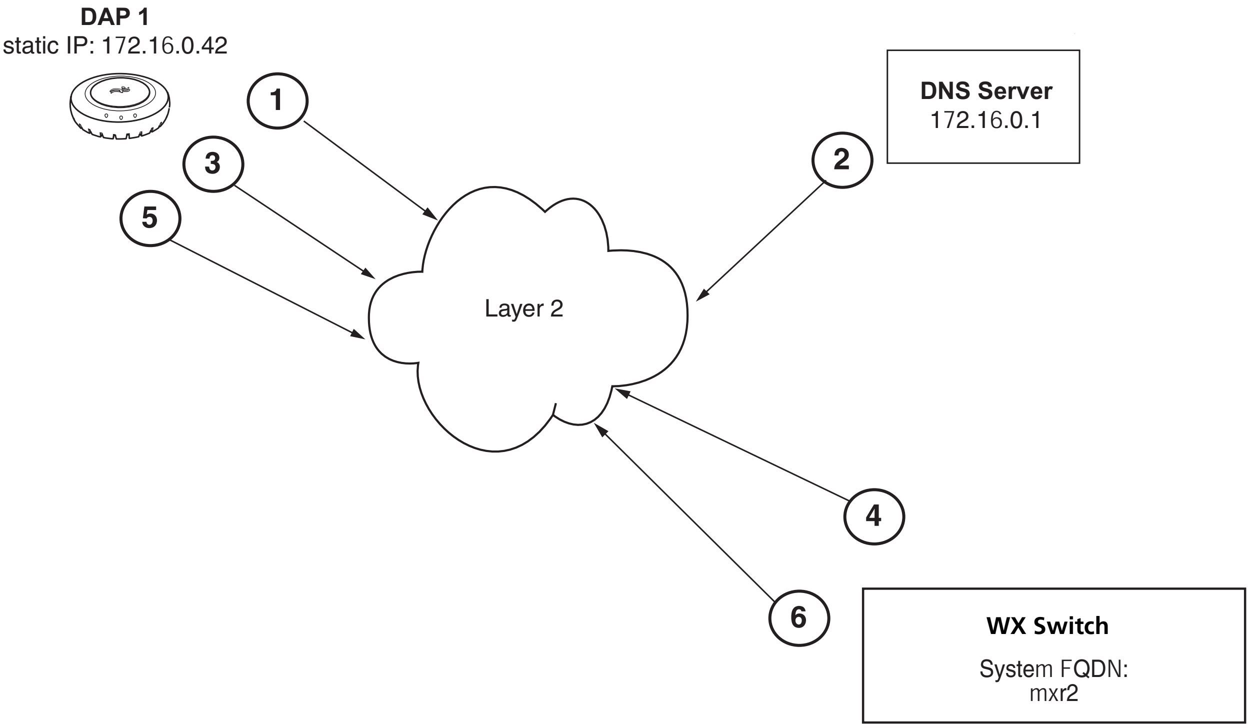
2 Because WX1 is configured for direct attachment, WX1 responds *privately* to the MAP and provides the MAP with its operational image (or indicates that the MAp should use a locally stored image) and configuration from WX1. Only in the event of a physical port failure would the MAP attempt to boot from its port 2, in which case both WX1 and WX2 would respond to the broadcast Find WX message.

Example Boot of MAP with Static IP Configuration

Figure 17 shows an example of the boot process for a MAP configured with static IP information. In the example, the MAP has been configured to use the following:

- Static IP address: 172.16.0.42, netmask: 255.255.255.0, default router 172.16.0.20
- Boot WX switch: wxr100, DNS server: 172.16.0.1

Figure 17 MAP Booting with a Static IP Address



After the MAP is configured with the above information, the next time the MAP boots, the following takes place:

1. The MAP sends an ARP request for its own address, to ensure it is not in use elsewhere in the network.
2. The DNS server resolves the fully qualified domain name of the WX switch, wxr100.
3. The MAP sends a Find WX message to the WX switch WXR100.
4. The WX switch WXR100 responds to the Find WX message
5. The MAP sends a unicast message to the WX switch WXR100 and determines whether it should use a locally stored image or download it from the WX switch.
6. Once the operational image is loaded, WX switch WXR100 sends configuration information to the MAP.

Service Profiles

A service profile controls advertisement and encryption for an SSID. You can specify the following:

- Whether SSIDs that use the service profile are beaconed
- Whether the SSIDs are encrypted or clear (unencrypted)
- For encrypted SSIDs, the encryption settings to use
- The *fallthru* authentication method for users that are not authenticated with 802.1X or MAC authentication

Table 10 lists the parameters controlled by a service profile and their default values.

Table 10 Defaults for Service Profile Parameters

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
attr	No attributes configured	Does not assign the SSID’s authorization attribute values to SSID users, even if attributes are not otherwise assigned.
auth-dot1x	**enable**	When the Wi-Fi Protected Access (WPA) information element (IE) is enabled, uses 802.1X to authenticate WPA clients.

Table 10 Defaults for Service Profile Parameters (continued)

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
auth-fallthru	**web-auth**	Uses WebAAA for users who do not match an 802.1X or MAC authentication rule for the SSID requested by the user.
auth-psk	**disable**	Does not support using a preshared key (PSK) to authenticate WPA clients.
beacon	**enable**	Sends beacons to advertise the SSID managed by the service profile.
cac-mode	**none**	Does not limit the number of active user sessions based on Call Admission Control (CAC).
cac-session	**14**	If session-based CAC is enabled (**cac-mode** is set to **session**), limits the number of active user sessions on a radio to 14.
cipher-ccmp	**disable**	Does not use Counter with Cipher Block Chaining Message Authentication Code Protocol (CCMP) to encrypt traffic sent to WPA clients.
cipher-tkip	**enable**	When the WPA IE is enabled, uses Temporal Key Integrity Protocol (TKIP) to encrypt traffic sent to WPA clients.
cipher-wep104	**disable**	Does not use Wired Equivalent Privacy (WEP) with 104-bit keys to encrypt traffic sent to WPA clients.
cipher-wep40	**disable**	Does not use WEP with 40-bit keys to encrypt traffic sent to WPA clients.
cos	**0**	If static CoS is enabled (**static-cos** is set to **enable**), assigns CoS 0 to all data traffic to or from clients.
dhcp-restrict	**disable**	Does not restrict a client's traffic to only DHCP traffic while the client is being authenticated and authorized.
idle-client-probing	**enable**	Sends a keepalive packet (a null-data frame) to each client every 10 seconds.
long-retry-count	**5**	Sends a long unicast frame up to five times without acknowledgment.

Table 10 Defaults for Service Profile Parameters (continued)

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
keep-initial-vlan	**disable**	Reassigns the user to a VLAN after roaming, instead of leaving the roamed user on the VLAN assigned by the switch where the user logged on. **Note:** Enabling this option does not retain the user's initial VLAN assignment in all cases.
no-broadcast	**disable**	Does not reduce wireless broadcast traffic by sending unicasts to clients for ARP requests and DHCP Offers and Acks instead of forwarding them as multicasts.
proxy-arp	**disable**	Does not reply on behalf of wireless clients to ARP requests for client IP addresses. Instead, the radio forwards the ARP Requests as wireless broadcasts.
psk-phrase	No passphrase defined	Uses dynamically generated keys rather than statically configured keys to authenticate WPA clients.
psk-raw	No preshared key defined	Uses dynamically generated keys rather than statically configured keys to authenticate WPA clients.
rsn-ie	disable	Does not use the RSN IE in transmitted frames.
shared-key-auth	disable	Does not use shared-key authentication. This parameter does not enable PSK authentication for WPA. To enable PSK encryption for WPA, use the **set radio-profile auth-psk** command.
short-retry-count	**5**	Sends a short unicast frame up to five times without acknowledgment.
soda	**disable**	Sygate On Demand Agent (SODA) files are not downloaded to connecting clients.
ssid-name	**3Com**	Uses the SSID name *3Com*.
ssid-type	**crypto**	Encrypts wireless traffic for the SSID.
static-cos	**disable**	Assigns CoS based on the QoS mode (**wmm** or **svp**) or based on ACLs.

Table 10 Defaults for Service Profile Parameters (continued)

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
tkip-mc-time	**60000**	Uses Michael countermeasures for 60,000 ms (60 seconds) following detection of a second MIC failure within 60 seconds.
transmit-rates	802.11a: ▪ mandatory: **6.0,12.0,24.0** ▪ beacon-rate: **6.0** ▪ multicast-rate: **auto** ▪ disabled: none 802.11b: ▪ mandatory: **1.0,2.0** ▪ beacon-rate: **2.0** ▪ multicast-rate: **auto** ▪ disabled: none 802.11g: ▪ mandatory: **1.0,2.0,5.5,11.0** ▪ beacon-rate: **2.0** ▪ multicast-rate: **auto** ▪ disabled: none	Accepts associations only from clients that support one of the mandatory rates. Sends beacons at the specified rate (6 Mbps for 802.11a, 2 Mbps for 802.11b/g). Sends multicast data at the highest rate that can reach all clients connected to the radio. Accepts frames from clients at all valid data rates. (No rates are disabled by default.)
user-idle-timeout	**180**	Allows a client to remain idle for 180 seconds (3 minutes) before MSS changes the client’s session to the Disassociated state.

Table 10 Defaults for Service Profile Parameters (continued)

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
web-portal-acl	**portalacl** **Note:** This is the default only if the fallthru type on the service profile has been set to **web-portal**. Otherwise, the value is unconfigured.	If set to **portalacl** and the service profile fallthru is set to **web-portal**, radios use the *portalacl* ACL to filter traffic for Web Portal users during authentication. If the fallthru type is **web-portal** but **web-portal-acl** is set to an ACL other than *portalacl*, the other ACL is used. If the fallthru type is not **web-portal**, radios do not use the **web-portal-acl** setting.
web-portal-form	Not configured	For WebAAA users, serves the default login web page or, if configured, the SSID-specific login web page.
web-portal-session-timeout	**5**	Allows a Web Portal WebAAA session to remain in the Deassociated state 5 seconds before being terminated automatically.
wep key-index	No keys defined	Uses dynamic WEP rather than static WEP. **Note:** If you configure a WEP key for static WEP, MSS continues to also support dynamic WEP.
wep active-multicast-index	1	Uses WEP key 1 for static WEP encryption of multicast traffic if WEP encryption is enabled and keys are defined.
wep active-unicast-index	1	Uses WEP key 1 for static WEP encryption of unicast traffic if WEP encryption is enabled and keys are defined.
wpa-ie	disable	Does not use the WPA IE in transmitted frames.

(To configure a service profile, see “Configuring a Service Profile” on page 233.)

Public and Private SSIDs

Each radio can support the following types of SSIDs:

- **Encrypted SSID** — Clients using this SSID must use encryption. Use the encrypted SSID for secured access to your enterprise network.
- **Clear SSID** — Clients using this SSID do not use encryption. Use the clear SSID for public access to nonsecure portions of your network.

All supported MAP models can support up to 32 SSIDs per radio. Each SSID can be encrypted or clear, and beaconing can be enabled or disabled on an individual SSID basis.

Each radio has 32 MAC addresses and can therefore support up to 32 SSIDs, with one MAC address assigned to each SSID as its BSSID. A MAP's MAC address block is listed on a label on the back of the access point. If the MAP is already deployed and running on the network, you can display the MAC address assignments by using the **display {ap | dap} status** command.

All MAC addresses on a MAP are assigned based on the MAP's base MAC address, as described in Table 11.

Table 11 MAC Address Allocations on MAPs

MAP	Model	Address Allocation
MAP	**All models**	The MAP has a base MAC address. All the other addresses are assigned based on this address.
Ethernet Ports	**All models**	Ethernet port 1 equals the MAP base MAC address. Ethernet port 2 (if the MAP model has one) equals the MAP base MAC address + 1.

Table 11 MAC Address Allocations on MAPs

Radios and SSIDs	**AP2750**	The radio MAC address equals the MAP base MAC address. The BSSIDs for the SSIDs configured on the radio end in even numbers. The first BSSID is equal to the MAP's base MAC address. The next BSSID is equal to the MAP's base MAC address + 2, and so on.
	AP7250 **AP8250** **AP8750**	All radio MAC addresses are dynamically allocated by the WX switch after the MAP boots. MSS allocates a unique block of eight consecutive addresses to each radio. Each SSID configured on the radio uses one of the addresses as its BSSID. MAC allocations are not persistent across a restart of the MAP, and a MAP might be allocated a different set of addresses following a restart.
	AP3150 **AP3750** **MP-352** **MP-262** **MP-252** **MP-52**	The 802.11b/g radio equals the MAP base MAC address. The BSSIDs for the SSIDs configured on the 802.11b/g radio end in even numbers. The first BSSID is equal to the MAP's base MAC address. The next BSSID is equal to the MAP's base MAC address + 2, and so on. The 802.11a radio equals the MAP base MAC address + 1. The BSSIDs for the SSIDs configured on the 802.11a radio end in odd numbers. The first BSSID is equal to the MAP's base MAC address + 1. The next BSSID is equal to the MAP's base MAC address + 3, and so on.
	MP-341 **MP-241**	The radio equals the MAP base MAC address. The BSSIDs for the SSIDs configured on the radio end in even numbers. The first BSSID is equal to the MAP's base MAC address. The next BSSID is equal to the MAP's base MAC address + 2, and so on.

Encryption

Encrypted SSIDs can use the following encryption methods:

- Wi-Fi Protected Access (WPA)
- Non-WPA dynamic Wired Equivalent Privacy (WEP)
- Non-WPA static WEP

Dynamic WEP is enabled by default.

(For more information, including configuration instructions, see Chapter 13, "Configuring User Encryption," on page 281.)

Radio Profiles

You can easily assign radio configuration parameters to many radios by configuring a radio profile and assigning the profile to the radios. To use a radio, you must assign a profile to the radio. You can enable the radio when you assign the profile.

Table 12 summarizes the parameters controlled by radio profiles. Generally, the only radio parameters controlled by the profile that you need to modify are the SSIDs and, if applicable, Wi-Fi Protected Access (WPA) settings. The other parameter settings are standard.

For information about the auto-tune parameters, see Table 25 on page 314.

Table 12 Defaults for Radio Profile Parameters

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
active-scan	**enable**	Sends *probe any* requests (probe requests with a null SSID name) to solicit probe responses from other access points. (See "Rogue Detection and Countermeasures" on page 567.)
beacon-interval	**100**	Waits 100 ms between beacons.
countermeasures	**Not configured**	Does not issue countermeasures against any device. (See "Rogue Detection and Countermeasures" on page 567.)
dtim-interval	**1**	Sends the delivery traffic indication map (DTIM) after every beacon.

Table 12 Defaults for Radio Profile Parameters (continued)

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
frag-threshold	**2346**	Uses the short-retry-count for frames shorter than 2346 bytes and uses the long-retry-count for frames that are 2346 bytes or longer.
max-rx-lifetime	**2000**	Allows a received frame to stay in the buffer for up to 2000 ms (2 seconds).
max-tx-lifetime	**2000**	Allows a frame that is scheduled for transmission to stay in the buffer for up to 2000 ms (2 seconds).
preamble-length	**short**	Advertises support for short 802.11b preambles, accepts either short or long 802.11b preambles, and generates unicast frames with the preamble length specified by the client. **Note**: This parameter applies only to 802.11b/g radios.
qos-mode	**wmm**	Classifies and marks traffic based on 802.1p and DSCP, and optimizes forwarding prioritization of MAP radios for Wi-Fi Multimedia (WMM).
rfid-mode	**disable**	Radio does not function as a location receiver in an AeroScout Visibility System.
rts-threshold	**2346**	Transmits frames longer than 2346 bytes by means of the Request-to-Send/Clear-to-Send (RTS/CTS) method.
service-profile	No service profiles defined	You must configure a service profile. The service profile sets the SSID name and other parameters.
wmm-powersave	**disable**	Requires clients to send a separate PSpoll to retrieve each unicast packet buffered by the MAP radio.

(To configure a radio profile, see "Configuring a Radio Profile" on page 240.)

RF Auto-Tuning

The RF Auto-Tuning feature dynamically assigns channel and power settings to MAP radios, and adjusts those settings when needed. RF Auto-Tuning can perform the following tasks:

- Assign initial channel and power settings when a MAP radio is started.
- Periodically assess the RF environment and change the channel or power setting if needed.
- Change the transmit data rate or power to maintain at least the minimum data rate with all associated clients.

By default, RF Auto-Tuning is enabled for channel configuration but disabled for power configuration.

(For more information, see Chapter 14, "Configuring RF Auto-Tuning," on page 311.)

Default Radio Profile

MSS contains one default radio profile, named default. To apply common parameters to radios, you can modify the default profile or create a new one. When you create a new profile, the radio parameters in the profile are set to their factory default values.

Radio-Specific Parameters

The channel number, transmit power, and external antenna parameters are unique to each radio and are not controlled by radio profiles. Table 13 lists the defaults for these parameters.

Table 13 Radio-Specific Parameters

Parameter	Default Value	Description
antennalocation	**indoors**	Location of the radio's antenna. Note: This parameter applies only to MAPs that support external antennas.

Table 13 Radio-Specific Parameters (continued)

Parameter	Default Value	Description
antennatype	For most MAP models, the default is **internal**. For MP-620, the default for the 802.11b/g radio is **ANT-1360-OUT**. The default for the 802.11a radio is **ANT-5360-OUT**. The default for the 802.11b/g radio on model MP-262 is **ANT1060**.	3Com external antenna model This parameter is configurable only on MAPs that support external antennas.
auto-tune max-power	Highest setting allowed for the country of operation or highest setting supported on the hardware, whichever is lower	Maximum percentage of client retransmissions a radio can experience before RF Auto-Tuning considers changing the channel on the radio. (To configure RF Auto-Tuning, see "Configuring RF Auto-Tuning" on page 311.)
channel	▪ **802.11b/g** — 6 ▪ **802.11a** — Lowest valid channel number for the country of operation	Number of the channel in which a radio transmits and receives traffic
mode	**disable**	Operational state of the radio.
radio-profile	None. You must add the radios to a radio profile.	802.11 settings
tx-power	Highest setting allowed for the country of operation or highest setting supported on the hardware, whichever is lower.	Transmit power of a radio, in decibels referred to 1 milliwatt (dBm)

Although these parameters have default values, 3Com recommends that you change the values for each radio for optimal performance. For example, leaving the channel number on each radio set to its default value can result in high interference among the radios.

(To configure these parameters, see "Configuring Radio-Specific Parameters" on page 246.)

Configuring MAPs

To configure MAPs, perform the following tasks, in this order:

- Specify the country of operation. (See "Specifying the Country of Operation" on page 213.)
- Configure an Auto-AP profile for automatic configuration of Distributed MAPs. (See "Configuring an Auto-AP Profile for Automatic MAP Configuration" on page 218.
- Configure MAPs and dual homing. (See "Configuring MAP Port Parameters" on page 224.)
- If required, configure the channel, transmit power, and external antenna type on each radio. (See "Configuring Radio-Specific Parameters" on page 246.)
- Configure a service profile to set SSID and encryption parameters. (See "Configuring a Service Profile" on page 233.)
- Configure a radio profile. (See "Configuring a Radio Profile" on page 240.)
- Map the radio profile to a service profile. (See "Mapping the Radio Profile to Service Profiles" on page 249.)
- Assign the radio profile to radios and enable the radios. (See "Assigning a Radio Profile and Enabling Radios" on page 249.)

Specifying the Country of Operation

You must specify the country in which you plan to operate the WX and its MAPs. MSS does not allow you to configure or enable the MAP radios until you specify the country of operation.

In countries where Dynamic Frequency Selection (DFS) is required, MSS performs the appropriate check for radar. If radar is detected on a channel, the MAP radio stops using the channel for the amount of time specified in the specified country's regulations. MSS also generates a log message to notify you when this occurs.

To specify the country, use the following command:

```
set system countrycode code
```

For the country, you can specify one of the codes listed in Table 14.

Table 14 Country Codes

Country	**Code**
Algeria	**DZ**
Argentina	**AR**
Australia	**AU**
Austria	**AT**
Bahrain	**BH**
Belgium	**BE**
Belize	**BZ**
Bolivia	**BO**
Boznia and Herzegovina	**BA**
Brazil	**BR**
Bulgaria	**BG**
Canada	**CA**
Chile	**CL**
China	**CN**
Colombia	**CO**
Costa Rica	**CR**
Cote d'Ivoire	**CI**
Croatia	**HR**
Cyprus	**CY**
Czech Republic	**CZ**
Denmark	**DK**
Dominican Republic	**DO**
Ecuador	**EC**
El Salvador	**SV**
Egypt	**EG**
Estonia	**EE**
Finland	**FI**
France	**FR**
Germany	**DE**
Greece	**GR**
Guatemala	**GT**

(continued)

Table 14 Country Codes (continued)

Country	Code
Honduras	**HN**
Hong Kong	**HK**
Hungary	**HU**
Iceland	**IS**
India	**IN**
Indonesia	**ID**
Ireland	**IE**
Israel	**IL**
Italy	**IT**
Jamaica	**JM**
Japan	**JP**
Jordan	**JO**
Kazakhstan	**KZ**
Kenya	**KE**
Kuwait	**KW**
Latvia	**LV**
Lebanon	**LB**
Liechtenstein	**LI**
Lithuania	**LT**
Luxembourg	**LU**
Macedonia, former Yugoslav Republic of	**MK**
Malaysia	**MY**
Malta	**MT**
Mauritius	**MU**
Mexico	**MX**
Morocco	**MA**
Namibia	**NA**
Netherlands	**NL**
New Zealand	**NZ**
Nigeria	**NG**
Norway	**NO**

(continued)

Table 14 Country Codes (continued)

Country	**Code**
Oman	**OM**
Pakistan	**PK**
Panama	**PA**
Paraguay	**PY**
Peru	**PE**
Philippines	**PH**
Poland	**PL**
Portugal	**PT**
Puerto Rico	**PR**
Qatar	**QA**
Romania	**RO**
Russia	**RU**
Saudi Arabia	**SA**
Serbia	**CS**
Singapore	**SG**
Slovakia	**SK**
Slovenia	**SI**
South Africa	**ZA**
South Korea	**KR**
Spain	**ES**
Sri Lanka	**LK**
Sweden	**SE**
Switzerland	**CH**
Taiwan	**TW**
Thailand	**TH**
Trinidad and Tobago	**TT**
Tunisia	**TN**
Turkey	**TR**
Ukraine	**UA**
United Arab Emirates	**AE**
United Kingdom	**GB**
United States	**US**

(continued)

Table 14 Country Codes (continued)

Country	**Code**
Uruguay	**UY**
Venezuela	**VE**
Vietnam	**VN**

The current software version might not support all of the countries listed here.

To verify the configuration change, use the following command:

`display system`

The following commands set the country code to US (United States) and verify the setting:

```
WX1200# set system countrycode US
success: change accepted.
WX1200# display system
===============================================================================
 Product Name:       WX1200
 System Name:        WX1200
 System Countrycode: US
 System Location:
 System Contact:
 System IP:          30.30.30.2
 System idle timeout:3600
 System MAC:         00:0B:0E:02:76:F6
===============================================================================
 Boot Time:          2003-05-07 08:28:39
 Uptime:                 0 days 04:00:07
===============================================================================
 Fan status:  fan1 OK fan2 OK fan3 OK
 Temperature: temp1 ok  temp2 ok  temp3 ok
 PSU Status:  Lower Power Supply DC ok AC ok  Upper Power Supply missing
 Memory:      115.09/496.04 (23%)
 Total Power Over Ethernet : 32.000
===============================================================================
```

Configuring an Auto-AP Profile for Automatic MAP Configuration

You can use an Auto-AP profile to deploy unconfigured Distributed MAPs. A Distributed MAP that does not have a configuration on a WX switch can receive its configuration from the Auto-AP profile instead.

The Auto-AP profile assigns a Distributed MAP number and name to the MAP, from among the unused valid MAP numbers available on the switch. The Auto-AP profile also configures the MAP with the MAP and radio parameter settings in the profile. The MAP and radio parameter settings in the Auto-AP profile are configurable. (See "Configuring an Auto-AP Profile" on page 220.)

The Auto-AP profile does not control SSIDs, encryption parameters, or any other parameters managed by service profiles. You still need to configure a service profile separately for each SSID.

A WX switch can have one Auto-AP profile.

How an Unconfigured MAP Finds a WX To Configure It

The boot process for a Distributed MAP that does not have a configuration on a WX switch is similar to the process for configured Distributed MAPs. After the MAP starts up, it uses DHCP to configure its IP connection with the network. The MAP then uses the IP connection to contact a WX switch.

The WX switch contacted by the MAP determines the best switch to use for configuring the MAP, and sends the MAP the IP address of that switch. The best switch to use for configuring the MAP is the switch that has an Auto-AP profile with a high bias setting. If more than one WX has an Auto-AP profile with a high bias setting, the switch that has the greatest capacity to add new unconfigured MAPs is selected.

A WX with the capacity to add new unconfigured Distributed MAP is the lesser of the following:

- Maximum number of MAPs that can be configured on the WX, minus the number that are configured
- Maximum number of MAPs that can be active on the WX, minus the number that are active

For example, suppose the Mobility Domain has two WX switches, with the capacities and loads listed in Table 15.

Table 15 Example WX1200 MAP Capacities and Loads

	WX1200 A	**WX1200 B**
Maximum Configured	30	30
Maximum Active	12	12
Number Currently Configured	25	20
Number Currently Active	8	12

For WX1200 A:

- The Number of MAPs that can be configured on the switch, minus the number that are configured, is 30 - 25 = 5.
- The Number of MAPs that can be active on the switch, minus the number that are active, is 12 - 8 = 4.
- The lesser of the two values is 4. The switch can have up to 4 more MAPs.

For WX1200 B:

- The Number of MAPs that can be configured on the switch, minus the number that are configured, is 30 - 20 = 10.
- The Number of MAPs that can be active on the switch, minus the number that are active, is 12 - 12 = 0.
- The lesser of the two values is 0. The switch can have no more MAPs.

WX1200 A has the capacity to add 4 more MAPs, whereas WX1200 B cannot add any more MAPs. Therefore, the WX contacted by the MAP sends WX1200 A's IP address to the MAP. The MAP then requests a software image file and configuration from WX1200 A. WX1200 A sends the software image and sends configuration parameters based on the Auto-AP profile.

Configured MAPs Have Precedence Over Unconfigured MAPs

When a WX determines the WX IP address to send to a booting MAP, the WX gives preference to MAPs that are already configured, over unconfigured MAPs that require an Auto-AP profile. The WX can direct a configured MAP to a WX that has active MAPs configured using the Auto-AP profile, even if the WX does not have capacity for more active MAPs. In this case, the WX randomly selects a MAP using the Auto-AP profile to disconnect, and accepts a connection from the configured MAP in its place.

The disconnected MAP can then begin the boot process again to find another WX switch that has an Auto-AP profile. When the MAP is disconnected, the MAP clients experience a service disruption, and will attempt to associate with another MAP if available to reconnect to the SSID they were using. If another MAP is not available to a client, the client can still reconnect after the disconnected MAP is connected to a new WX and finishes the boot and configuration process.

Configuring an Auto-AP Profile

The Auto-AP profile for Distributed MAP configuration is like an individual MAP configuration, except the configuration has the name *auto* instead of a Distributed MAP number.

To create an Auto-AP profile for automatic Distributed MAP configuration, type the following command:

```
WX1200# set ap auto
success: change accepted.
```

To display the MAP settings in the Auto-AP profile, type the following command:

```
WX1200# display ap <apnum> config auto
Dap auto: mode: disabled bias: high
fingerprint
boot-download-enable: YES
force-image-download: NO
Radio 1: type: 802.11g, mode: enabled, channel: dynamic
tx pwr: 15, profile: default
auto-tune max-power: default
Radio 2: type: 802.11a, mode: enabled, channel: dynamic
tx pwr: 11, profile: default
auto-tune max-power: default
```

This example shows the defaults for the MAP parameters you can configure in the Auto-AP profile. Table 16 lists the configurable Auto-AP profile parameters and their defaults. The only parameter that requires configuration is the Auto-AP profile mode. The Auto-AP profile is disabled by default. To use the Auto-AP profile to configure Distributed MAPs, you must enable the profile. (See "Enabling the Auto-AP Profile" on page 222.)

Table 16 Configurable Profile Parameters for Distributed MAPs

Parameter	**Default Value**
MAP Parameters	
bias	**high**
blink (Not shown in **display ap config** output)	**disable**
force-image download	**disable (NO)**
group (load balancing group)	none
mode	**disabled**
persistent	none
upgrade-firmware (boot-download-enable)	**enable** (YES)
Radio Parameters	
radio *num* **auto-tune max-power**	default
radio *num* **mode**	enabled
radio *num* **radio-profile**	**default**
radiotype	11g (or 11b for country codes where 802.11g is not allowed)

MAPs that receive their configurations from the Auto-AP profile also receive the radio settings from the radio profile used by the Auto-AP profile. Likewise, the SSIDs and encryption settings come from the service profiles mapped to the radio profile. To use a radio profile other than *default*, you must specify the radio profile you want to use. (See "Specifying the Radio Profile Used by the Auto-AP Profile" on page 222.)

Changing MAP Parameter Values The commands for configuring MAP and radio parameters for the Auto-AP profile are the same as the commands for configuring an individual Distributed MAP. Instead of specifying a Distributed MAP number with the command, specify **auto**.

For more information about the syntax, see the "MAP Commands" chapter of the *Wireless LAN Switch and Controller Command Reference*.

MAP Parameters:

```
set dap auto bias {high | low}
set dap auto blink {enable | disable}
set dap auto force-image-download {enable | disable}
set dap auto group name
set dap auto mode {enable | disable}
set dap auto persistent [apnumber | all]
set dap auto upgrade-firmware {enable | disable}
```

Radio Parameters:

```
set dap auto radiotype {11a | 11b | 11g}
set dap auto radio {1 | 2} auto-tune max-power power-level
set dap auto radio {1 | 2} mode {enable | disable}
set dap auto radio {1 | 2} radio-profile name mode {enable |
disable}
```

Enabling the Auto-AP Profile To enable the Auto-AP profile for automatic Distributed MAP configuration, type the following command:

```
WX# set ap auto mode enable
success: change accepted.
```

Specifying the Radio Profile Used by the Auto-AP Profile The Auto-AP profile uses radio profile *default* by default. To use another radio profile instead, use the following command:

```
set ap auto radio {1 | 2}
radio-profile name mode {enable | disable}
```

The following command changes the Auto-AP profile to use radio profile *autodap1* for radio 1:

```
WX# set ap auto radio 1 radio-profile autodap1
success: change accepted.
```

You must configure the radio profile before you can apply it to the Auto-AP profile.

Displaying Status Information for MAPs Configured by the Auto-AP Profile

To display status information for MAPs configured by the Auto-AP profile, type the following command:

```
WX# display ap status auto
AP: 7, AP model: AP3750, manufacturer 3Com, name: MAP07
    ====================================================
State:      operational (not encrypted)
CPU info:   IBM:PPC speed=266666664 Hz version=405GPr
                  id= ram=33554432
                  s/n=0333703027 hw_rev=A3
Uptime:     18 hours, 36 minutes, 27 seconds
Radio 1 type: 802.11g, state: configure succeed [Enabled] (802.11b protect)
      operational channel: 1 operational power: 14
      base mac: 00:0b:0e:00:d2:c0
      bssid1: 00:0b:0e:00:d2:c0, ssid: public
      bssid2: 00:0b:0e:00:d2:c2, ssid: employee-net
      bssid3: 00:0b:0e:00:d2:c4, ssid: mycorp-tkip
Radio 2 type: 802.11a, state: configure succeed [Enabled]
      operational channel: 64 operational power: 14
      base mac: 00:0b:0e:00:d2:c1
      bssid1: 00:0b:0e:00:d2:c1, ssid: public
      bssid2: 00:0b:0e:00:d2:c3, ssid: employee-net
      bssid3: 00:0b:0e:00:d2:c5, ssid: mycorp-tkip
```

The output displays *auto* next to the Distributed MAP number to indicate that the MAP was configured using an Auto-AP profile.

Converting a MAP Configured by the Auto-AP Profile into a Permanent MAP You can convert a temporary MAP configuration created by the Auto-AP profile into a persistent MAP configuration on the WX switch. To do so, use the following command:

```
set ap auto persistent {apnumber | all}
```

This command creates a persistent Distributed MAP configuration based on the settings in the Auto-AP profile. The Distributed MAP name and number assigned by the Auto-AP profile are used for the persistent entry. For example, if the Auto-AP profile assigned the number 100 and the name DAP100 to the MAP, the persistent configuration for the MAP has the same number and name. In this case, use **100** as the *apnumber* with **display ap**, **set ap**, or **clear ap** commands.

The MAP continues to operate without interruption after you enter the **set ap auto persistent** command. The next time the MAP is restarted, the Auto-AP profile is not used to configure the MAP. Instead, the persistent configuration is used. (Use the **save config** command to make the MAP configuration persistent across switch restarts.)

Configuring MAP Port Parameters

To configure a WX to connect to a MAP, see "Configuring a MAP" on page 224.

Optionally, you also can change other parameters that affect the entire MAP:

- MAP name. (See "Changing MAP Names" on page 227.)
- Dual-home bias. (See "Changing Bias" on page 227.)
- Automatic firmware upgrade capability. (See "Disabling or Reenabling Automatic Firmware Upgrades" on page 228.)
- LED blink mode. (See "Enabling LED Blink Mode" on page 229.)

(For information about configuring RF Auto-Tuning settings on a radio, see Chapter 14, "Configuring RF Auto-Tuning," on page 311.)

Table 17 lists how many MAPs you can configure on a WX switch, and how many MAPs a switch can boot. The numbers are for directly connected and Distributed MAPs combined.

Table 17 Configurable and Bootable MAPs per WX Switch

WX Switch Model	Maximum Configured	Maximum Booted
WX4400	300	24, 48, 72, 96, or 120 depending on the license.
WX2200	320	24, 48, 72, 96, or 120, depending on the license.
WX1200	30	12
WXR100	8	3

Configuring a MAP

Configure the MAP using the following command:

```
set ap apnumber serial-id serial-ID
model {2330 | 2330A | AP2750 | AP3750 | mp-52 | mp-241 |
mp-252 | mp-262 | mp-341 | mp-352 | mp-372 | mp-372-CN |
mp-372-JP | mp-422 | mp-620} [radiotype {11a | 11b | 11g}]
```

To configure a MAP model MP-372 with serial-ID 0322199999, type the following command:

```
WX# set ap 1 serial-id 0322199999 model mp-372
success: change accepted.
```

(To specify the external antenna type, use the **set ap radio antennatype** command. See "Configuring the External Antenna Model and Location" on page 247.)

Configuring Static IP Addresses on Distributed MAPs

By default, Distributed MAPs use the procedure described in "How a Distributed MAP Obtains an IP Address through DHCP" on page 189 to obtain an IP address and connect to a WX switch. In some installations, DHCP may not be available. In such a case, you can manually assign static IP address information to the MAP.

You can also optionally specify the WX switch the Distributed MAP uses as its boot device, and an 802.1Q VLAN tag to be applied to Ethernet frames emitted from the distributed MAP.

When you configure static IP information for a Distributed MAP, it uses the boot procedure described in "How a Distributed MAP Contacts a WX Switch (Statically Configured Address)" on page 193 instead of the default boot procedure.

Specifying IP Information To specify static IP address information for a Distributed MAP, use the following command:

```
set ap apnumber boot-ip ip ip-addr netmask mask-addr gateway
gateway-addr [mode {enable | disable}]
```

To configure Distributed MAP 1 to use IP address 172.16.0.42 with a 24-bit netmask, and use 172.16.0.20 as its default router (gateway), type the following command:

```
WX1200# set ap 1 boot-ip ip 172.16.0.42 netmask 255.255.255.0
gateway 172.16.0.20 mode enable
success: change accepted.
```

The next time the Distributed MAP is booted, it will use the specified IP information. If the manually assigned IP information is incorrect, the MAP uses DHCP to obtain its IP address, as described in "How a Distributed MAP Obtains an IP Address through DHCP" on page 189.

Specifying WX Switch Information To specify the WX switch a Distributed MAP contacts and attempts to use as its boot device, use the following command:

```
set ap apnumber boot-switch [switch-ip ip-addr] [name name
dns ip-addr] [mode {enable | disable}]
```

You can specify the WX switch by its fully qualified domain name; in this case, you also specify the address of the DNS server used to resolve the WX switch's name. If you specify both the address of the WX switch, *and* the WX switch's name and DNS server address, then the MAP ignores the WX switch's address and uses the name.

When a static IP address is specified for a Distributed MAP, there is no preconfigured DNS information or DNS name for the WX switch the Distributed MAP attempts to use as its boot device. If you configure a static IP address for a Distributed MAP, but do not specify a boot device, then the WX switch must be reachable via subnet broadcast.

The following command configures Distributed MAP 1 to use the WX switch with address 172.16.0.21 as its boot device.

```
WX# set ap 1 boot-switch switch-ip 172.16.0.21 mode enable
success: change accepted.
```

The following command configures Distributed MAP 1 to use the WX switch with the name wxr100 as its boot device. The DNS server at 172.16.0.1 is used to resolve the name of the WX switch.

```
wx1200# set ap 1 boot-switch name wxr100 dns 172.16.0.1 mode
enable
success: change accepted.
```

Specifying VLAN information To specify 802.1Q VLAN tagging information for a Distributed MAP, use the following command:

```
set ap apnumber boot-vlan vlan-tag tag-value [mode {enable |
disable}]
```

When this command is configured, all Ethernet frames emitted from the Distributed MAP are formatted with an 802.1Q tag with a specified VLAN number. Frames sent to the Distributed MAP that are not tagged with this value are ignored.

The following command configures Distributed MAP 1 to use VLAN tag 100:

```
WX1200# set ap 1 boot-vlan vlan-tag 100 mode enable
success: change accepted.
```

Clearing a MAP from the Configuration

To clear MAP settings from a port, use the following command:

When you clear a MAP, MSS ends user sessions that are using the MAP.

```
clear port type port-list
```

This command resets the port as a network port and removes all MAP-related parameters from the port.

*The **clear port type** command does not place the cleared port in any VLAN, not even in the default VLAN (VLAN 1). To use the cleared port in a VLAN, you must add the port to the VLAN. (For instructions, see "Adding Ports to a VLAN" on page 92.)*

To clear a MAP, use the following command:

```
clear ap apnumber
```

Changing MAP Names

The default name of a directly attached MAP is based on the port number of the MAP access port attached to the MAP. For example, the default name for a MAP on MAP access port 1 is *MAP01*. The default name of a Distributed MAP is based on the number you assign to it when you configure the connection. For example, the default name for Distributed MAP 1 is *AP01*.

MAP names appear in the output of some CLI **display** commands and in 3Com Wireless Switch Manager. To change the name of a MAP, use the following command:

```
set ap apnumber name name
```

Changing Bias

The CLI commands described in this section enable you to change the bias for a MAP.

To change the bias of a MAP, use the following command:

```
set ap apnumber bias {high | low}
```

The default bias is high.

To change the bias for a Distributed MAP to low, type the following command:

```
WX# set ap 1 bias low
success: change accepted.
```

Disabling or Reenabling Automatic Firmware Upgrades

A MAP can automatically upgrade its boot firmware by loading the upgrade version of the firmware from a WX switch when the MAP is booting. Automatic firmware upgrades are enabled by default.

To disable or reenable automatic firmware upgrades, use the following command:

```
set ap apnumber upgrade-firmware {enable | disable}
```

Forcing a MAP To Download its Operational Image from the WX

A MAP's operational image is the software that allows it to function on the network as a wireless access point. As part of the MAP boot process, an operational image is loaded into the MAP's RAM and activated. The MAP stores copies of its operational image locally, in its internal flash memory. At boot time, the MAP can either load the locally stored image, or it can download an operational image from the WX switch to which it has connected.

By default, a MAP model that can locally store a software image on the MAP will load the locally stored image instead of downloading its image from the WX switch.

To force the MAP to always download its image from the WX switch instead, use the following command:

```
set {ap port-list | dap dap-num} force-image-download {enable
| disable}
```

A change to the forced image download option takes place the next time the MAP is restarted.

Even when forced image download is disabled (the default), the MAP still checks with the WX switch to verify that the MAP has the latest image, and to verify that the WX is running MSS Version 5.0 or later.

The MAP loads its local image only if the WX is running MSS Version 5.0 or later and does not have a newer MAP image than the one in the MAP's local storage. If the switch is not running MSS Version 5.0 or later, or the WX has a newer version of the MAP image than the version in the MAP's local storage, the MAP loads its image from the WX.

The forced image download option is not applicable to MAP models MP-52, MP-101, and MP-122.

Enabling LED Blink Mode

When blink mode is enabled on an AP2750, the 11a LED blinks on and off. By default, LED blink mode is disabled. If enabled, blink mode continues until you disable it.

When blink mode is enabled on an AP7250, the Radio LED flashes red and the Power LED flashes green/orange. The Ethernet LED does not change.

Changing the LED blink mode does not alter operation of the MAP. Only the behavior of the LEDs is affected.

To enable or disable LED blink mode, use the following command:

```
set ap apnumber blink {enable | disable}
```

Configuring MAP-WX Security

MSS provides security for management traffic between WX switches and Distributed MAPs. When the feature is enabled, all management traffic between Distributed MAPs that support encryption and the WX is encrypted. MAP-WX security is set to **optional** by default.

The encryption uses RSA as the public key crypto system, with AES-CCM for data encryption and integrity checking and HMAC-MD5 for keyed hashing and message authentication during the key exchange. Bulk data protection is provided by AES in CCM mode (AES CTR for encryption and AES-CBC-MAC for data integrity). A 64-bit Message Authentication Code is used for data integrity

This feature applies to Distributed MAPs only, not to directly connected MAPs configured on MAP access ports.

The maximum transmission unit (MTU) for encrypted MAP management traffic is 1498 bytes, whereas the MTU for unencrypted management traffic is 1474 bytes. Make sure the devices in the intermediate network between the WX switch and Distributed MAP can support the higher MTU.

Encryption Key Fingerprint

MAPs are configured with an encryption key pair at the factory. The fingerprint for the public key is displayed on a label on the back of the MAP, in the following format:

```
RSA
aaaa:aaaa:aaaa:aaaa:
aaaa:aaaa:aaaa:aaaa
```

If the MAP is already installed, you can display the fingerprint in MSS. (See "Finding the Fingerprint" on page 231.)

Encryption Options

By default, a WX can configure and manage a Distributed MAP regardless of whether the MAP has an encryption key, and regardless of whether you have confirmed the fingerprint by setting it in MSS.

You can configure a WX to require Distributed MAPs to have an encryption key. In this case, the WX also requires their fingerprints to be confirmed in MSS. When MAP security is required, a MAP can establish a management session with the WX only if its fingerprint has been confirmed in MSS.

If you do not want any MAPs to use encryption for management information, you can disable the feature.

Table 18 lists the MAP security options and whether a MAP can establish a management session with a WX based on the option settings.

Table 18 MAP Security Requirements

MAP Security Setting	MAP Has Fingerprint?	Fingerprint Verified in MSS?	MAP Can Establish Management Session with Switch?
MAP Security Required	Yes	Yes	Yes
		No	No
	No	Not Applicable	No
MAP Security Optional	Yes	Yes	Yes*
		No	Yes*
	No	Not Applicable	Yes

* MSS generates a log message listing the MAP serial number and fingerprint so you can verify the MAP's identity. (See "Fingerprint Log Message" on page 233.)

Verifying a MAP Fingerprint on a WX Switch

To verify a MAP fingerprint, find the fingerprint and use the **set ap fingerprint** command to enter the fingerprint in MSS.

Finding the Fingerprint A MAP fingerprint is listed on a label on the back of the MAP. (See "Encryption Key Fingerprint" on page 230.)

If the MAP is already installed and operating, use the **display ap status** command to display the fingerprint. The following example shows information for Distributed MAP 8, including its fingerprint:

```
WX# display ap status 8
AP: 7, AP model: AP3750, manufacturer: 3Com, name: AP08
         fingerprint: b4:f9:2a:52:37:58:f4:d0:10:75:43:2f:45:c9:52:c3
====================================================
State:     operational (not encrypted)
CPU info:  IBM:PPC speed=266666664 Hz version=405GPr
                  id=0x29f1886d447f111a ram=33554432
                  s/n=0424000779 hw_rev=A3
Uptime:    1 hours, 8 minutes, 17 seconds

Radio 1 type: 802.11g, state: configure succeed [Enabled]
       operational channel: 1 operational power: 1
       base mac: 00:0b:0e:0a:60:00
       bssid1: 00:0b:0e:0a:60:00, ssid: public
       bssid2: 00:0b:0e:0a:60:02, ssid: 3Com
Radio 2 type: 802.11a, state: configure succeed [Enabled]
       operational channel: 48 operational power: 11
       base mac: 00:0b:0e:0a:60:01
       bssid1: 00:0b:0e:0a:60:01, ssid: public
       bssid2: 00:0b:0e:0a:60:03, ssid: 3Com
```

The fingerprint is displayed regardless of whether it has been verified in MSS.

*The **display ap config** command lists a MAP fingerprint only if the fingerprint has been verified in MSS. If the fingerprint has not been verified, the fingerprint info in the command output is blank*

Verifying a Fingerprint on a WX Switch To verify a MAP fingerprint, find the fingerprint and use the set ap fingerprint command to enter the fingerprint in MSS.

Setting the MAP Security Requirement on a WX

You can configure the WX to require all Distributed MAPs to have encryption keys. In this case, the WX does not establish a management session with a Distributed MAP unless the MAP has a key, and you have confirmed the fingerprint of the key in MSS.

A change to MAP security support does not affect management sessions that are already established. To apply the new setting to a MAP, restart the MAP.

To configure MAP security requirements, use the following command:

```
set ap security {require | optional | none}
```

The **require** option enforces encryption of management traffic for all Distributed MAPs, and requires the key fingerprints to be confirmed in MSS. The **none** option disables encryption of management traffic for all Distributed MAPs. The default is optional, which allows connection to MAPs with or without encryption.

The following command configures a WX to require Distributed MAPs to have encryption keys:

```
WX# set ap security require
```

Fingerprint Log Message

If MAP encryption is optional, and a MAP whose fingerprint has not been verified in MSS establishes a management session with the WX, MSS generates a log message such as the following:

```
AP-HS:(secure optional)configure AP M9DE48B012F00 with
fingerprint c6:98:9c:41:32:ab:37:09:7e:93:79:a4:ca:dc:ec:fb
```

The message lists the serial number and fingerprint of the MAP. You can check this information against your records to verify that the MAP is authentic.

Configuring a Service Profile

A service profile is a set of parameters that control advertisement (beaconing) and encryption for an SSID, as well as default authorization attributes that apply to users accessing the SSID.

This section describes how to create a service profile and set some basic SSID parameters. To configure other service profile parameters, see the following:

- Chapter 13, "Configuring User Encryption," on page 281.
- Chapter 15, "Configuring Quality of Service" on page 327
- "Configuring the Web Portal WebAAA Session Timeout Period" on page 477
- "Assigning SSID Default Attributes to a Service Profile" on page 493.
- Chapter 24, "Configuring SODA Endpoint Security for a WX Switch," on page 543

(For a list of the parameters controlled by service profiles and their defaults, see Table 10 on page 202.)

(To display service profile settings, see "Displaying Service Profile Information" on page 259.)

Creating a Service Profile

To create a service profile and assign an SSID to it, use the following command:

```
set service-profile name ssid-name ssid-name
```

An SSID can be up to 32 alphanumeric characters long.

You can include blank spaces in the name, if you delimit the name with single or double quotation marks. You must use the same type of quotation mark (either single or double) on both ends of the string.

The following command configures a service profile named *corp1*, and assigns SSID *mycorp_rnd* to it:

```
WX1200# set service-profile corp1 ssid-name mycorp_rnd
success: change accepted.
```

The following command applies the name *corporate users* to the SSID managed by service profile *mycorp_srvcprf*:

```
WX1200# set service-profile mycorp_srvcprf ssid-name
“corporate users”
success: change accepted.
```

Removing a Service Profile

To remove a service profile, use the following command:

```
clear service-profile name
[soda {agent-directory | failure-page | remediation-acl |
success-page | logout-page}]
```

The **soda** options reset Sygate On-Demand (SODA) settings to their default values. If you omit the **soda** option, the service profile specified by *name* is completely removed.

Changing a Service Profile Setting

To change a setting in a service profile without removing the profile, use the **set service-profile** command for the setting you want to change. Do not use the **clear service-profile** command.

Disabling or Reenabling Encryption for an SSID

To specify whether the SSID is encrypted or unencrypted, use the following command:

```
set service-profile name ssid-type [clear | crypto]
```

The default is **crypto.**

Disabling or Reenabling Beaconing of an SSID

To specify whether the SSID is beaconed, use the following command:

```
set service-profile name beacon {enable | disable}
```

SSIDs are beaconed by default.

A MAP radio responds to an 802.11 *probe any* request only for a beaconed SSID. A client that sends a *probe any* request receives a separate response for each of the beaconed SSIDs supported by a radio. For a nonbeaconed SSID, radios respond only to directed 802.11 probe requests that match the nonbeaconed SSID's SSID string.

When you disable beaconing for an SSID, the radio still sends beacon frames, but the SSID name in the frames is blank.

Changing the Fallthru Authentication Type

By default, MSS uses WebAAA for users who do not match an 802.1X or MAC authentication rule, and therefore *fall through* these authentication types. You can change the *fallthru* method to last-resort or none.

To change the fallthru method, use the following command:

```
set service-profile name auth-fallthru
{last-resort | none | web-auth}
```

(For more information about network user authentication, see "Configuring AAA for Network Users" on page 433.)

Changing Transmit Rates

Each type of radio (802.11a, 802.11b, and 802.11g) that provides service to an SSID has a set of rates the radio is allowed to use for sending beacons, multicast frames, and unicast data. The rate set also specifies the rates clients must support in order to associate with a radio.

Table 19 lists the rate settings and their defaults.

Table 19 Transmit Rates

Parameter	Default Value	Description
mandatory	▪ 11a— **6.0,12.0,24.0** ▪ 11b—**1.0,2.0** ▪ 11g—**1.0,2.0,5.5,11.0**	Set of data transmission rates that clients are required to support in order to associate with an SSID on a MAP radio. A client must support at least one of the mandatory rates. These rates are advertised in the basic rate set of 802.11 beacons, probe responses, and reassociation response frames sent by MAP radios. Data frames and management frames sent by MAP radios use one of the specified mandatory rates. The valid rates depend on the radio type: ▪ **11a**—6.0, 9.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0 ▪ **11b**—1.0, 2.0, 5.5, 11.0 ▪ **11g**—1.0, 2.0, 5.5, 6.0, 9.0, 11.0, 12.0, 18.0, 24.0, 36.0, 48.0, 54.0 Use a comma to separate multiple rates; for example: **6.0,9.0,12.0**
disabled	None. All rates applicable to the radio type are supported by default.	Data transmission rates that MAP radios will not use to transmit data. This setting applies only to data sent by the MAP radios. The radios will still accept frames from clients at disabled data rates. The valid rates depend on the radio type and are the same as the valid rates for **mandatory**. If you disable a rate, you cannot use the rate as a mandatory rate or the beacon or multicast rate. All rates that are applicable to the radio type and that are not disabled are supported by the radio.
beacon-rate	▪ 11a—**6.0** ▪ 11b—**2.0** ▪ 11g—**2.0**	Data rate of beacon frames sent by MAP radios. This rate is also used for probe-response frames. The valid rates depend on the radio type and are the same as the valid rates for **mandatory**. However, you cannot set the beacon rate to a disabled rate.

Table 19 Transmit Rates (continued)

Parameter	Default Value	Description
multicast-rate	**auto** for all radio types	Data rate of multicast frames sent by MAP radios. ■ *rate*—Sets the multicast rate to a specific rate. The valid rates depend on the radio type and are the same as the valid rates for **mandatory**. However, you cannot set the multicast rate to a disabled rate. ■ **auto**—Sets the multicast rate to the highest rate that can reach all clients connected to the MAP radio.

To change transmit rates for a service profile, use the following command:

```
set service-profile name transmit-rates {11a | 11b | 11g}
mandatory rate-list [disabled rate-list] [beacon-rate rate]
[multicast-rate {rate | auto}]
```

The following command sets 802.11a mandatory rates for service profile *sp1* to 6 Mbps and 9 Mbps, disables rates 48 Mbps and 54 Mbps, and changes the beacon rate to 9 Mbps:

```
WX1200# set service-profile sp1 transmit-rates 11a mandatory
6.0,9.0 disabled 48.0,54.0 beacon-rate 9.0
success: change accepted.
```

Enforcing the Data Rates

By default, the rate set is not enforced, meaning that a client can associate with and transmit data to the MAP using a disabled data rate, although the MAP does not transmit data back to the client at the disabled rate.

You can configure MSS to enforce the data rates, which means that a connecting client *must* transmit at one of the mandatory or standard rates in order to associate with the MAP. When data rate enforcement is enabled, clients transmitting at the disabled rates are not allowed to associate with the MAP.

Data rate enforcement is useful if you want to completely prevent clients from transmitting at disabled data rates. For example, you can disable slower data rates so that clients transmitting at these rates do not consume bandwidth on the channel at the expense of clients transmitting at faster rates.

Data rate enforcement is disabled by default. To enable data rate enforcement for a radio profile, use the following command:

```
set radio-profile profile-name rate-enforcement mode {enable
| disable}
```

For example, the following command enables data rate enforcement for radio profile *rp1.*

```
WX# set radio-profile rp1 rate-enforcement mode enable
```

The following command sets a 802.11g mandatory rate for service profile *sp1* to 54 Mbps and disables rates 1.0 Mbps and 2.0 Mbps:

```
WX# set service-profile sp1 transmit-rates 11g mandatory 54.0
disabled 1.0,2.0
```

The following command maps radio profile *rp1* to service profile *sp1*.

```
WX# set radio-profile rp1 service-profile sp1
```

After these commands are entered, if a client transmitting with a data rate of 1.0 Mbps or 2.0 Mbps attempts to associate with a MAP managed by service profile *sp1*, that client is not allowed to associate with the MAP.

Disabling Idle-Client Probing

By default, a MAP radio sends keepalive messages (idle-client probes) every 10 seconds to each client that has an active session on the radio, to verify that the client is still active. The probes are unicast null-data frames. Normally, a client that is still active sends an Ack in reply to an idle-client probe.

If a client does not send any data or respond to any idle-client probes before the user idle timeout expires (see "Changing the User Idle Timeout" on page 239), MSS changes the client's session to the Disassociated state.

Responding to keepalive messages requires power use by a client. If you need to conserve power on the client (for example, on a VoIP handset), you can disable idle-client probing.

To disable or reenable idle-client probing, use the following command:

```
set service-profile name idle-client-probing {enable |
disable}
```

The following command disables idle-client probing on service profile *sp1*:

```
WX1200# set service-profile sp1 idle-client-probing disable
success: change accepted.
```

Changing the User Idle Timeout

The user idle timeout specifies the number of seconds a client can remain idle before the WX changes the client's session to the Disassociated state. A client is considered to be idle if it does not send data and does not respond to idle-client probes. You can specify a timeout value from 20 to 86400 seconds. The default is 180 seconds (3 minutes). To disable the user-idle timeout, set it to 0.

To change the user-idle timeout, use the following command:

```
set service-profile name user-idle-timeout seconds
```

The following command increases the user idle timeout to 360 seconds (6 minutes):

```
WX1200# set service-profile sp1 user-idle-timeout 360
success: change accepted.
```

Changing the Short Retry Threshold

The short retry threshold specifies the number of times a radio can send a short unicast frame for an SSID without receiving an acknowledgment for the frame. A short unicast frame is a frame that is *shorter* than the RTS threshold.

To change the short retry threshold, use the following command:

```
set service-profile name short-retry threshold
```

The threshold can be a value from 1 through 15. The default is 5.

To change the short retry threshold for service profile *sp1* to 3, type the following command:

```
WX1200# set service-profile sp1 short-retry 3
success: change accepted.
```

Changing the Long Retry Threshold

The long retry threshold specifies the number of times a radio can send a long unicast frame for an SSID without receiving an acknowledgment for the frame. A long unicast frame is a frame that is *equal to or longer than* the RTS threshold.

To change the long retry threshold, use the following command:

```
set service-profile name long-retry threshold
```

The threshold can be a value from 1 through 15. The default is 5.

To change the long retry threshold for service profile *sp1* to 8, type the following command:

```
WX1200# set service-profile sp1 long-retry 8
success: change accepted.
```

Configuring a Radio Profile

A radio profile is a set of parameters that apply to multiple radios. You can easily assign configuration parameters to many radios by configuring a profile and assigning the profile to the radios.

To configure a radio profile:

- Create a new profile.
- Change radio parameters.
- Map the radio profile to one or more service profiles.

(For a list of the parameters controlled by radio profiles and their defaults, see Table 12 on page 209.)

The channel number, transmit power, and external antenna type are unique to each radio and are not controlled by radio profiles. (To configure these parameters, see “Configuring Radio-Specific Parameters” on page 246.)

(To display radio profile information, see “Displaying Radio Profile Information” on page 260.)

Creating a New Profile

To create a radio profile, use the following command:

```
set radio-profile name [mode {enable | disable}]
```

Specify a name of up to 16 alphanumeric characters. Do not include the **mode enable** or **mode disable** option.

After you create the radio profile, you can use the **enable** and **disable** options to enable or disable all radios that use the profile.

To configure a new radio profile named *rp1*, type the following command:

```
WX1200# set radio-profile rp1
success: change accepted.
```

To assign the profile to one or more radios, use the **set ap radio radio-profile** command. (See "Assigning a Radio Profile and Enabling Radios" on page 249.)

Changing Radio Parameters

To change individual parameters controlled by a radio profile, use the commands described in the following sections.

You must disable all radios that are using a radio profile before you can change parameters in the profile. (See "Disabling or Reenabling All Radios Using a Profile" on page 250.)

Changing the Beacon Interval The beacon interval is the rate at which a radio advertises its beaconed SSID(s). To change the beacon interval, use the following command:

```
set radio-profile name beacon-interval interval
```

The interval can be a value from 25 ms through 8191 ms. The default is 100.

The beacon interval does not change even when advertisement is enabled for multiple SSIDs. MSS still sends one beacon for each SSID during each beacon interval.

To change the beacon interval for radio profile *rp1* to 200 ms, type the following command:

```
WX1200# set radio-profile rp1 beacon-interval 200
success: change accepted.
```

Changing the DTIM Interval The DTIM interval specifies the number of times after every beacon that a radio sends a delivery traffic indication map (DTIM). A MAP sends the multicast and broadcast frames stored in its buffers to clients who request them in response to the DTIM. The DTIM interval applies to both the beaconed SSID and the unbeaconed SSID.

The DTIM interval does not apply to unicast frames. A MAP also stores unicast frames in buffer memory, but the MAP includes information about the buffered unicast frames in each beacon frame. When a user station receives a beacon frame that advertises unicast frames destined for the station, the station sends a request for the frames and the MAP transmits the requested frames to the user station.

To change the DTIM interval, use the following command:

```
set radio-profile name dtim-interval interval
```

The interval can be a value from 1 through 31. The default is 1.

To change the DTIM interval for radio profile *rp1* to 2, type the following command:

```
WX1200# set radio-profile rp1 dtim-interval 2
success: change accepted.
```

Changing the RTS Threshold The RTS threshold specifies the maximum length a frame can be before a radio uses the Request-to-Send/Clear-to-Send (RTS/CTS) method to send the frame. The RTS/CTS method clears the air of other traffic to avoid corruption of the frame due to a collision with another frame.

When a frame is long enough for the RTS/CTS method to be applicable, the radio sends a Request-To-Send (RTS) message addressed to the intended receiver for the frame. The receiver replies with a Clear-To-Send (CTS) message. When the radio receives the CTS message, the radio transmits the frame and waits for an acknowledgment from the receiver. The radio does not transmit additional frames until receiving the acknowledgment.

Any other user station that overhears the RTS or CTS message stops transmitting until the station overhears the acknowledgment message.

To change the RTS threshold, use the following command:

```
set radio-profile name rts-threshold threshold
```

The threshold can be a value from 256 bytes through 3000 bytes. The default is 2346.

To change the RTS threshold for radio profile *rp1* to 1500 bytes, type the following command:

```
WX1200# set radio-profile rp1 rts-threshold 1500
success: change accepted.
```

Changing the Fragmentation Threshold The fragmentation threshold specifies the longest a frame can be without being fragmented into multiple frames by a radio before transmission. To change the fragmentation threshold, use the following command:

```
set radio-profile name frag-threshold threshold
```

The threshold can be a value from 256 through 2346. The default is 2346.

To change the fragmentation threshold for radio profile *rp1* to 1500 bytes, type the following command:

```
WX1200# set radio-profile rp1 frag-threshold 1500
success: change accepted.
```

Changing the Maximum Receive Threshold The maximum receive threshold specifies the number of milliseconds a frame *received* by a radio can remain in buffer memory. To change the maximum receive lifetime, use the following command:

```
set radio-profile name max-rx-lifetime time
```

The time can be from 500 ms (0.5 second) through 250,000 ms (250 seconds). The default is 2000 ms (2 seconds).

To change the maximum receive threshold for radio profile *rp1* to 4000 ms, type the following command:

```
WX1200# set radio-profile rp1 max-rx-lifetime 4000
success: change accepted.
```

Changing the Maximum Transmit Threshold The maximum transmission threshold specifies the number of milliseconds a frame *scheduled to be transmitted* by a radio can remain in buffer memory. To change the maximum transmit lifetime, use the following command:

```
set radio-profile name max-tx-lifetime time
```

The time can be from 500 ms (0.5 second) through 250,000 ms (250 seconds). The default is 2000 ms (2 seconds).

To change the maximum transmit threshold for radio profile *rp1* to 4000 ms, type the following command:

```
WX1200# set radio-profile rp1 max-tx-lifetime 4000
success: change accepted.
```

Changing the Preamble Length By default, 802.11b/g radios advertise support for frames with short preambles and can support frames with short or long preambles.

An 802.11b/g radio generates unicast frames to send to a client with the preamble length specified by the client. An 802.11b/g radio always uses a long preamble in beacons, probe responses, and other broadcast or multicast traffic.

Generally, clients assume access points require long preambles and request to use short preambles only if the access point with which they are associated advertises support for short preambles. You can disable the advertisement of support for short preambles by setting the preamble length value to **long**. In this case, clients assume that the access point supports long preambles only and the clients request long preambles.

Changing the preamble length value affects only the support advertised by the radio. Regardless of the preamble length setting (**short** or **long**), an 802.11b/g radio accepts and can generate 802.11b/g frames with either short or long preambles.

If any client associated with an 802.11b/g radio uses long preambles for unicast traffic, the MAP still accepts frames with short preambles but does not transmit any frames with short preambles. This change also occurs if the access point overhears a beacon from an 802.11b/g radio on another access point that indicates the radio has clients that require long preambles.

The default preamble length value is **short**. This command does not apply to 802.11a radios.

To change the preamble length advertised by 802.11b/g radios, use the following command:

```
set radio-profile name preamble-length {long | short}
```

To configure 802.11b/g radios that use the radio profile *rp_long to* advertise support for long preambles instead of short preambles, type the following command:

```
WX1200# set radio-profile rp_long preamble-length long
success: change accepted.
```

Resetting a Radio Profile Parameter to its Default Value

To reset a radio profile parameter to its default value, use the following command:

```
clear radio-profile name parameter
```

The *parameter* can be one of the radio profile parameters listed in Table 12 on page 209.

Make sure you specify the radio profile parameter you want to reset. If you do not specify a parameter, MSS deletes the entire profile from the configuration.

All radios that use this profile must be disabled before you can delete the profile. If you specify a parameter, the setting for the parameter is reset to its default value. The settings of the other parameters are unchanged and the radio profile remains in the configuration. If you do not specify a parameter, the entire radio profile is deleted from the configuration.

To disable the radios that are using radio profile *rp1* and reset the **beaconed-ssid** parameter to its default value, type the following commands:

```
WX1200# set radio-profile rp1 mode disable
WX1200# clear radio-profile rp1 beaconed-ssid
success: change accepted.
```

Removing a Radio Profile

To remove a radio profile, use the following command:

```
clear radio-profile name
```

You must disable all radios that are using a radio profile before you can remove the profile. (See "Disabling or Reenabling All Radios Using a Profile" on page 250.)

To disable the radios that are using radio profile *rptest* and remove the profile, type the following commands:

```
WX1200# set radio-profile rptest mode disable
WX1200# clear radio-profile rptest
success: change accepted.
```

Configuring Radio-Specific Parameters

This section shows how to configure the channel and transmit power on individual radios, and how to configure for external antennas. (For information about the parameters you can set on individual radios, see Table 13.)

Configuring the Channel and Transmit Power

To set the channel and transmit power of a radio, use the following commands:

```
set ap apnumber radio {1 | 2} channel channel-number
set ap apnumber radio {1 | 2} tx-power power-level
```

If RF Auto-Tuning is enabled for channels or power, you cannot set the channels or power manually using the commands in this section. See Chapter 14, "Configuring RF Auto-Tuning," on page 311.

To set the channel and transmit power of a radio, use the following commands:

```
set ap apnumber radio {1 | 2} channel channel-number
set ap apnumber radio {1 | 2} tx-power power-level
```

The parameters are shown in separate commands for simplicity. However, you can use the **channel** and **tx-power** parameters on the same command line.

Specify **1** or **2** for the radio number:

- For a single-radio model, specify **radio 1**.
- For the 802.11b/g radio in a two-radio model, specify **radio 1**.
- For the 802.11a radio in a two-radio model, specify **radio 2**.

The maximum transmit power you can configure on any 3Com radio is the highest setting allowed for the country of operation or the highest setting supported on the hardware, whichever is lower.

To configure the 802.11b radio on port 1 for channel 1 with a transmit power of 10 dBm, type the following command:

```
WX1200# set ap 1 radio 1 channel 1 tx-power 10
success: change accepted.
```

To configure the 802.11a radio on port 5 for channel 36 with a transmit power of 10 dBm, type the following command:

```
WX1200# set ap 5 radio 2 channel 36 tx-power 10
success: change accepted.
```

You also can change the channel and transmit power on an individual basis.

Configuring the External Antenna Model and Location

Table 20 lists the external antenna models you can use on 3Com MAP models AP2750, AP3150, AP3750, AP7250, AP8250, and AP8750. The AP2750 supports all antennas listed in the table except model ANT3C598. The other 3Com MAP models support all the external antenna models listed in the table.

Table 20 AP2750, AP3150, AP3750, AP7250, AP8250, AP8750 External Antennas Models

Model	Type	Gain (dBi)	Description
ANT3C591	802.11a 802.11b/g	8 6	High-gain omnidirectional
ANT3C592	802.11a 802.11b/g	4 3	Ceiling
ANT3C597	802.11a 802.11b/g	8 6	Hallway
ANT3C598	802.11a 802.11b/g	10 8	Panel

The 3Com AP3750 Managed Access Point has connectors for attaching optional external 802.11a or 802.11b/g antennas. The 802.11b/g radios in MAP models MP-341 and MP-352 have an internal antenna but can use an external antenna. The MP-262 802.11b/g radio requires an external antenna.

Table 21 lists the external antenna models you can use with these MAPs.

Table 21 MP-341, MP-352, MP-262 External Antenna Models

		Beamwidth	
Model	**Type**	**Horizontal**	**Vertical**
ANT-5060 (ASTN6S)*	802.11a	60°	14°
ANT-5120 (ASTN6T)	802.11a	120°	14°
ANT-5180 (ASTN6H)	802.11a	180°	14°
ANT1060	802.11b/g	60°	65°
ANT1120	802.11b/g	120°	60°
ANT1180	802.11b/g	180°	40°

Table 22 lists the external antenna models you can use with the MP-620.

Table 22 MP-620 External Antenna Models

			Beamwidth	
Model	**Radio Type**	**Gain (dBi)**	**Horizontal**	**Vertical**
ANT-1360-OUT (WA6202-ANT-8G)*	802.11b/g	8	360°	15°
ANT-5360-OUT (WA5201M-ANT-8A-1)	802.11a	8	360°	12°
ANT-5060-OUT (WA5201M-ANT-17A)	802.11a	17	60°	6°
ANT-5120-OUT (WA5201M-ANT-14A)	802.11a	14	120°	6°

* The numbers in parentheses are the numbers that appear on the antennas. The numbers beginning *ANT* are the part numbers and are the numbers you specify when configuring the MAP. To verify an external antenna's model number, look for the number in parentheses.

Specifying the External Antenna Model

To specify the external antenna model, use the following command:

```
set ap apnumber radio {1 | 2} antennatype
{ANT1060 | ANT1120 | ANT1180 |
ANT5060 | ANT5120 | ANT5180 | ANT7360
ANT-1360-OUT | ANT-5360-OUT | ANT-5060-OUT | ANT-5120-OUT |
ANT-7360-OUT | internal}
```

To configure antenna model ANT1060 for an MP-262 on MAP 1, type the following command:

```
WX1200# set ap 1 radio 1 antennatype ANT1060
success: change accepted.
```

Specifying the External Antenna Location

In some cases, the set of valid channels for a radio differs depending on whether the antenna is located indoors or outdoors. You can ensure that the proper set of channels is available on the radio by specifying the antenna's location (**indoors** or **outdoors**). The default location is indoors.

To change an external antenna's location, use the following command:

```
set {ap port-list | dap dap-num} antenna-location {indoors |
outdoors}
```

Mapping the Radio Profile to Service Profiles

To assign SSIDs to radios, you must map the service profiles for the SSIDs to the radio profile that is assigned to the radios.

To map a radio profile to a service profile, use the following command:

```
set radio-profile name service-profile name
```

The following command maps service-profile *wpa_clients* to radio profile *rp2*:

```
WX1200# set radio-profile rp2 service-profile wpa_clients
success: change accepted.
```

Assigning a Radio Profile and Enabling Radios

To assign a radio profile to radios, use the following command:

```
set ap apnumber radio {1 | 2} radio-profile name
mode {enable | disable}
```

To assign radio profile *rp1* to radio 1 on ports 1-3 and 6 and enable the radios, type the following command:

```
WX1200# set ap 1-3,6 radio 1 radio-profile rp1 mode enable
success: change accepted.
```

To assign radio profile *rp1* to radio 2 on ports 1-4 and port 6 and enable the radios, type the following command:

```
WX1200# set ap 1-4,6 radio 2 radio-profile rp1 mode enable
success: change accepted.
```

To disable radio 1 on port 6 without disabling the other radios using radio profile *rp1*, type the following command:

```
WX1200# set ap 6 radio 1 radio-profile rp1 mode disable
```

(To disable or reenable all radios that are using a radio profile, see "Disabling or Reenabling All Radios Using a Profile" on page 250.)

Disabling or Reenabling Radios

You can disable or reenable radios on a radio profile basis or individual basis. You also can reset a radio to its factory default settings.

(To disable or reenable radios when assigning or removing a radio profile, see "Assigning a Radio Profile and Enabling Radios" on page 249.)

Enabling or Disabling Individual Radios

To disable or reenable a MAP radio, use the following command:

```
set ap apnumber radio {1 | 2} mode {enable | disable}
```

To disable radio 2 on port 3 and 6, type the following command:

```
WX1200# set ap 3,6 radio 2 mode disable
success: change accepted.
```

Disabling or Reenabling All Radios Using a Profile

To disable or reenable all radios that are using a radio profile, use the following command:

```
set radio-profile name [mode {enable | disable}]
```

The following command enables all radios that use radio profile *rp1*:

```
WX1200# set radio-profile rp1 mode enable
success: change accepted.
```

The following commands disable all radios that use radio profile *rp1*, change the beacon interval, then reenable the radios:

```
WX1200# set radio-profile rp1 mode disable
success: change accepted.
WX1200# set radio-profile rp1 beacon-interval 200
success: change accepted.
WX1200# set radio-profile rp1 mode enable
success: change accepted.
```

Resetting a Radio to its Factory Default Settings

To disable a MAP radio and reset it to its factory default settings, use the following command:

```
clear ap apnumber radio {1 | 2 | all}
```

This command performs the following actions:

- Sets the transmit power, channel, and external antenna type to their default values.
- Removes the radio from its radio profile and places the radio in the default radio profile.

This command does not affect the PoE setting.

To disable and reset radio 2 on the MAP connected to port 3, type the following command:

```
WX1200# clear ap 3 radio 2
```

Restarting a MAP

To restart a MAP, use the following command:

```
reset ap apnumber
```

Use the **reset ap** command to reset a MAP configured on a MAP access port. Use the **reset ap** command to reset a Distributed MAP.

When you enter one of these commands, the MAP drops all sessions and reboots.

Restarting a MAP can cause data loss for users who are currently associated with the MAP.

Configuring Local Packet Switching on MAPs

MAPs can be configured to perform *local packet switching*. Local packet switching allows packets to be switched directly from the MAP to the wired network, instead of passing through an intermediate WX switch. When a MAP is configured to perform local switching, the WX switch is removed from the forwarding path for client data traffic.

When local switching is enabled, the client VLAN is directly accessible through the wired interface on the MAP. Packets can be switched directly to and from this interface.

Normally, when local switching is not enabled on a MAP, packets are tunneled through the network back to a WX, where the traffic is placed on the client VLAN. This process requires packets to be encapsulated, de-encapsulated, and possibly fragmented, which may introduce latency in the switching path.

Omitting the WX switch from the forwarding path for client traffic eliminates the tunnel encapsulation process, which can result in improved network performance.

Local packet switching is disabled by default. A MAP can be configured to switch packets for some VLANs locally and tunnel packets for other VLANs through the WX.

Notes:

- Restricting Layer 2 forwarding for a VLAN is not supported if the VLAN is configured for local switching
- The DHCP restrict feature is not supported for locally switched clients
- Web Portal is not supported for locally switched clients
- A directly attached MaP, for which a port has been specified with the **set port type** command, cannot be configured to perform local switching. However, a directly connected MaP for which a port has not been specified can perform local switching.
- IGMP snooping is not supported with local switching

Configuring Local Switching

Configuring a MAP to perform local switching consists of the following tasks:

- Configuring a *VLAN profile* for the MAP, which specifies the VLANs that are to be locally switched
- Enabling local switching on the MAP
- Applying the VLAN profile to the MAP

In addition, the VLAN profile can be cleared from the MAP, or removed from the WX switch.

Configuring a VLAN Profile

A VLAN profile consists of a list of VLANs and tags. When a VLAN profile is applied to a MAP, traffic for the VLANs specified in the VLAN profile is locally switched by the MAP instead of being tunneled back to a WX switch.

To add VLANs to a VLAN profile, use the following command:

```
set vlan-profile profile-name vlan vlan-name [tag tag-value]
```

You enter a separate **set vlan-profile** command for each VLAN you want to add to the VLAN profile. A VLAN profile can contain up to 128 entries. When the optional *tag-value* is set, it is used as the 802.1Q tag for the VLAN.

To add an entry for VLAN *red* to VLAN profile *locals*, type the following command:

```
WX# set vlan-profile locals vlan red
success: change accepted.
```

Enabling Local Switching on a MAP

To enable local switching for a specified MAP, use the following command:

```
set ap apnumber local-switching mode {enable | disable}
```

Local switching can be enabled on MAPs that are connected to the WX switch via an intermediate Layer 2 or Layer 3 network. Local switching is not supported for MAPs that are directly connected to a WX.

To enable local switching for MAP 7, type the following command:

```
WX# set ap 7 local-switching mode enable
success: change accepted.
```

Applying a VLAN Profile to a MAP

To apply a VLAN profile to a MAP to use with local switching, use the following command:

```
set ap apnumber local-switching vlan-profile profile-name
```

When a VLAN profile is applied to a MAP, traffic for the VLANs specified in the VLAN profile is locally switched by the MAP instead of being tunneled back to a WX switch.

If local switching is enabled on a MAP, but no VLAN profile is configured, then a default VLAN profile is used. The default VLAN profile includes a single VLAN named *default* that is not tagged.

When applying a VLAN profile causes traffic that had been tunneled to a WX switch to be locally switched by MAPs, or vice-versa, the sessions of clients associated with the MAPs where the VLAN profile is applied are terminated, and the clients must re-associate with the MAPs.

To specify that MAP 7 use VLAN profile *locals*, type the following command:

```
WX# set ap 7 local-switching vlan-profile locals
success: change accepted.
```

Clearing the VLAN Profile from a MAP

To clear the VLAN profile that had been applied to a MAP, use the following command:

```
clear ap ap-number local-switching vlan-profile
```

When the VLAN profile is cleared from the MAP, traffic that had been locally switched is tunneled to a WX switch.

When clearing a VLAN profile causes traffic that had been locally switched by MAPs to be tunneled to a WX switch, the sessions of clients associated with the MAPs where the VLAN profile is applied are terminated, and the clients must re-associate with the MAPs.

To clear the VLAN profile that had been applied to MAP 7, type the following command:

```
WX# clear ap 7 local-switching vlan-profile
success: change accepted.
```

Removing a VLAN Profile from the WX Switch

To remove a VLAN profile or individual entries from a VLAN profile, use the following command:

```
clear vlan-profile profile-name [vlan vlan-name]
```

You can use this command to remove individual VLANs from a VLAN profile, or to remove an entire VLAN profile. If you remove all of the entries from a VLAN profile, the VLAN profile itself is removed.

If a VLAN profile is changed so that traffic that had been tunneled to a WX switch is now locally switched by MAPs, or vice-versa, the sessions of clients associated with the MAPs where the VLAN profile is applied are terminated, and the clients must re-associate with the MAPs.

To remove the entry for VLAN *red* from VLAN profile *locals* type the following command:

```
WX# clear vlan-profile locals vlan red
WX#
```

To remove VLAN profile *locals*, type the following command:

```
WX# clear vlan-profile locals
WX#
```

Displaying MAP Information

You can display the following MAP information:

- MAP and radio-specific configuration settings
- Connection information for Distributed MAPs configured on a WX
- List of Distributed MAPs that are not configured on a WX
- Connection information for Distributed MAPs
- Service profile information
- Radio profile information
- Status information
- Information about static IP addresses on Distributed MAPs
- Statistics counters
- Information about VLAN profiles configured for local switching
- ARP table on an MSP
- Forwarding Database (FDB) for an MSP
- Information about the VLANs locally switched by a MAP
- Information about ACLs used by the MAP

Displaying MAP Configuration Information

To display configuration information, use the following commands:

```
display ap config [apnumber [radio {1 | 2}]]
```

The command lists information separately for each MAP.

To display configuration information for MAP 59, type the following command:

```
WX1200# display ap config 59
AP 59: serial-id: 1231, AP model: MP-422, bias: high, name:
AP59
        upgrade-firmware: YES
        force-image-download:  NO
        communication timeout: 10
        location:
        contact:
  Radio 1: type: 802.11g, mode: disabled, channel: dynamic
  tx pwr: 18, profile: default
  auto-tune max-power: default,
  load-balance-group: ,
  load-balance-enable: YES,
  force-rebalance: NO,
  Radio 2: type: 802.11a, mode: disabled, channel: dynamic
  tx pwr: 17, profile: default
  auto-tune max-power: default,
  load-balance-group: ,
  load-balance-enable: YES,
  force-rebalance: NO,
  local-switching: enabled, vlan-profile: locals
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Connection Information for Distributed MAPs

To display connection information for Distributed MAPs configured on a WX switch, use the following command:

```
display ap global [apnumber | serial-id serial-ID]
```

This command lists the System IP addresses of all the WX switches on which each Distributed MAP is configured, and lists the bias for the MAP on each switch. For each Distributed MAP that is configured on the switch on which you use the command, the connection number is also listed.

Connections are shown only for the Distributed MAPs that are configured on the WX from which you enter the command, and only for the Mobility Domain the WX is in.

To display connection information for all Distributed MAPs configured on a WX switch, type the following command:

```
WX4400# display ap global
Total number of entries: 8
AP  Serial Id     WX IP Address Bias
--- ------------  --------------- ----
1   M9DE48B012F00 10.3.8.111      HIGH
-   M9DE48B012F00 10.4.3.2        LOW
2   M9DE48B123400 10.3.8.111      LOW
-   M9DE48B123400 10.4.3.2        HIGH
17  M9DE48B123600 10.3.8.111      HIGH
-   M9DE48B123600 10.4.3.2        LOW
18  M9DE48B123700 10.3.8.111      LOW
-   M9DE48B123700 10.4.3.2        HIGH
```

This command indicates that the Mobility Domain contains four Distributed MAPs, with serial IDs M9DE48B012F00, M9DE48B123400, M9DE48B123600, and M9DE48B123700. Each MAP is configured on two WX switches, with system IP addresses 10.3.8.111 and 10.4.3.2. The bias for the MAP on each WX is listed. Normally, a Distributed MAP boots from the WX with the high bias for the MAP. (For more information, see "Resiliency and Dual-Homing Options for MAPs" on page 184 and "Boot Process for Distributed MAPs" on page 189.)

The AP field indicates the connection number of each MAP on the WX on which the command is typed. A hyphen (-) in the DAP field indicates that the MAP is configured on another WX in the same Mobility Domain.

Displaying a List of Distributed MAPs that Are Not Configured

To display a list on Distributed MAPs that are not configured, use the following command:

```
display ap unconfigured
```

The following command displays information for two Distributed MAPs that are not configured:

```
WX1200# display ap unconfigured
Total number of entries: 2
Serial Id     Model  IP Address       Port Vlan
-----------   ------ ---------------- ---- --------
0333001287    MP-101 10.3.8.54        5    default
M9DE48B012F00 AP2750 10.3.8.57        6    vlan-eng
```

Displaying Active Connection Information for Distributed MAPs

A Distributed MAP can have only one active data connection. To display the system IP address of the WX that has the active connection (the switch that booted the MAP), use the following command:

```
display ap connection [apnumber | serial-id serial-ID]
```

The **serial-id** parameter displays the active connection for a Distributed MAP even if that MAP is not configured on this WX. However, if you use the command with the *apnumber* parameter or without a parameter, connection information is displayed only for Distributed MAPs that are configured on this WX.

This command provides information only if the Distributed MAP is configured on the WX where you use the command.

The WX does not need to be the one that booted the MAP, but it must have the MAP in its configuration. Also, the WX that booted the MAP must be in the same Mobility Domain as the WX where you use the command.

Displaying Service Profile Information

To display service profile information, use the following command:

`display service-profile` `{`*`name`*` | `**`?`**`}`

Entering **display service-profile ?** displays a list of the service profiles configured on the switch.

To display information for service profile *sp1*, type the following command:

```
WX# display service-profile sp1
ssid-name:                       corp2    ssid-type:                   crypto
Beacon:                            yes       Proxy ARP:                     no
DHCP restrict:                      no       No broadcast:                  no
Short retry limit:                   5       Long retry limit:               5
Auth fallthru:                    none       Sygate On-Demand (SODA):       no
Enforce SODA checks:               yes       SODA remediation ACL:
Custom success web-page:                     Custom failure web-page:
Custom logout web-page:                      Custom agent-directory:
Static COS:                         no       COS:                            0
CAC mode:                         none       CAC sessions:                  14
User idle timeout:                 180       Idle client probing:          yes
Keep initial vlan:                  no       Web Portal Session Timeout:     5
Web Portal ACL:
WEP Key 1 value:                <none>       WEP Key 2 value:           <none>
WEP Key 3 value:                <none>       WEP Key 4 value:           <none>
WEP Unicast Index:                   1       WEP Multicast Index:            1
Shared Key Auth:                    NO
WPA enabled:
    ciphers: cipher-tkip
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
vlan-name = orange
session-timeout = 300
service-type = 2
11a beacon rate:                   6.0        multicast rate:             AUTO
11a mandatory rate: 6.0,12.0,24.0 standard rates: 9.0,18.0,36.0,48.0,54.0
11b beacon rate:                   2.0        multicast rate:             AUTO
11b mandatory rate: 1.0,2.0 standard rates: 5.5,11.0
11g beacon rate:                   2.0        multicast rate:             AUTO
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Radio Profile Information

To display radio profile information, use the following command:

```
display radio-profile {name | ?}
```

Entering **display radio-profile ?** displays a list of radio profiles.

To display radio profile information for the default radio profile, type the following command:

```
WX# display radio-profile default
Beacon Interval:                   100   DTIM Interval:                     1
Max Tx Lifetime:                  2000   Max Rx Lifetime:                2000
RTS Threshold:                    2346   Frag Threshold:                 2346
Long Preamble:                      no   Tune Channel:                    yes
Tune Channel Range (11a):  lower-bands   Ignore Clients:                   no
Tune Power:                         no   Tune Channel Interval:          3600
Tune Power Interval:               600   Power ramp interval:              60
Channel Holddown:                  300   Countermeasures:                none
Active-Scan:                       yes   RFID enabled:                     no
WMM Powersave:                      no   QoS Mode:                        wmm
Rate Enforcement:                   no   Initial Load:                   1000
ETT Link Factor:                     3   Change Threshold:                 25
Dwell Time:                       3600   Probe Interval:                   60
Intial Measur Interval:             60   Maximum Measure Interval:        600
Radio Link Timeout:                  5
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying MAP Status Information

To display status information including link state and WX status, use the following commands:

```
display ap status [terse] | [apnumber | all [radio {1 | 2}]]
```

The **terse** option displays a brief line of essential status information for each directly connected MAP or Distributed MAP.

The **all** option displays information for all directly attached MAPs and all Distributed MAPs configured on the switch.

The following command displays the status of a Distributed MAP:

```
WX# display ap status 1
AP: 7, AP model: AP3750, manufacturer 3Com, name: MAP07
====================================================
State:     operational (not encrypt)
CPU info:  IBM:PPC speed=266666664 Hz version=405GPr, ram=33554432
                   s/n=0333703050 hw_rev=A3
Uptime:    531 hours, 37 minutes, 28 seconds
Radio 1 type: 802.11g, state: configure succeed [Disabled] (Sweep mode)
      operational channel: 1 (Auto) operational power: 1
      bssid1: 00:0b:0e:00:ca:c0, ssid: techpubs
      bssid2: 00:0b:0e:00:ca:c2, ssid: techpubs-wpa
      load balance: enabled, current load: (unavailable)
      RFID Reports: Inactive
Radio 2 type: 802.11a, state: configure succeed [Disabled] (Sweep mode)
      operational channel: 40 (Auto) operational power: 1
      bssid1: 00:0b:0e:00:ca:c1, ssid: chloe
      load balance: enabled, current load: (unavailable)
      RFID Reports: Inactive
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Static IP Address Information for Distributed MAPs

To display information about Distributed MAPs that have been configured with static IP address information, use the following command:

display ap boot-configuration *apnumber*

To display statistics counters for Distributed MAP 1, type the following command:

```
WX# display ap boot-configuration 1
Static Boot Configuration
AP: 7
IP Address: Disabled
VLAN Tag:   Disabled
Switch:     Disabled
Mesh:       Disabled
IP Address:
Netmask:
Gateway:
VLAN Tag:
Switch IP:
Switch Name:
```

```
DNS IP:
Mesh SSID:
Mesh PSK:
```

For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying MAP Statistics Counters

To display MAP statistics counters, use the following commands:

display ap counters [*apnumber* [**radio** {**1** | **2**}]]

To display statistics counters for Distributed MAP 7, type the following command:

```
WX# display ap counters 7
AP: 7 radio: 1
=================================
LastPktXferRate         36               PktTxCount             14855302
NumCntInPwrSave         0                MultiPktDrop           0
LastPktRxSigStrength    -75              MultiBytDrop           0
LastPktSigNoiseRatio    20               User Sessions          0
TKIP Pkt Transfer Ct    0                MIC Error Ct           0
TKIP Pkt Replays        0                TKIP Decrypt Err       0
CCMP Pkt Decrypt Err    0                CCMP Pkt Replays       0
CCMP Pkt Transfer Ct    0                RadioResets            0
Radio Recv Phy Err Ct   0                Transmit Retries       0
Radio Adjusted Tx Pwr   0                Noise Floor            -90
802.3 Packet Tx Ct 0    802.3            Packet Rx Ct           0
No Receive Descriptor   0                Invalid Rates          0
     TxUniPkt       TxUniByte      RxPkt     RxByte       UndcrptPkt
        TxMultiPkt      TxMultiByte                          UndcrptByte
                                                                  PhyErr
1.0:   0         0   0          0   502648   67698076   0   0    2592086
2.0:   0  14849546   0 2066952151    37537    2107316   0   0   25187852
5.5:   0         0   0          0    73167   11803093   0   0       9311
6.0:   0         0   0          0   434213  231595484   0   0        462
9.0:   0         0   0          0      541     223968   0   0          0
11.0:  0         0   0          0   129686   30105586   0   0       2774
12.0:  0         0   0          0     9016     612251   0   0          4
18.0:  0         0   0          0    29052    3427179   0   0         96
24.0:  0         0   0          0    96325    9941100   0   0         924
36.0:  0         0   0          0   136912   17914903   0   0        5846
48.0:  0         0   0          0   176674   41518676   0   0         563
54.0:  0         0   0          0  1231544  387008280   0   0       15705
TOTL:  0  14849546   0 2066952151  2857315  803955912   0   0    27815623
...
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

To display statistics counters and other information for individual user sessions, use the **display sessions network** command. (For information, see Chapter 25, “Managing Sessions,” on page 557.)

Displaying VLAN Profile Information

To display the contents of the VLAN profiles configured on the WX switch, use the following command:

```
display vlan-profile [profile-name]
```

The command lists the names and tags for each VLAN in the VLAN profile, as well as the MAPs to which the VLAN profile has been applied.

To display the contents of VLAN profile *locals* type the following command:

```
WX# display vlan-profile locals
vlan-profile: locals
Vlan Name    Tag
---------    ---
blue         none
red          45
ap numbers: 67
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying the ARP Table for a MAP

To display the ARP table for a specified MAP, use the following command:

```
display ap arp apnumber
```

The following command displays ARP entries for AP 7:

```
WX# display ap arp 7
AP 7:
Host                   HW Address                 VLAN    State     Type
-------------------    -----------------          ----   --------  -------
10.5.4.51              00:0b:0e:00:04:0c             1   EXPIRED   DYNAMIC
10.5.4.53              00:0b:0e:02:76:f7             1   RESOLVED  LOCAL
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying the Forwarding Database for a MAP

To display the entries in a specified MAP forwarding database, use the following command:

display ap fdb *apnumber*

The following command displays FDB entries for AP 7:

```
WX# display ap fdb 7
AP 7:
# = System Entry. $ = Authenticate Entry
VLAN   TAG Dest MAC/Route Des [CoS] Destination Ports
----  ---- ------------------ ----- -----------------
4095  4095 00:0b:0e:00:ca:c1     #       CPU
4095     0 00:0b:0e:00:04:0c            eth0
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying VLAN Information for a MAP

To display information about the VLANs that are either locally switched by the specified MAP or tunneled from the MAP to a WX switch, use the following command:

display ap vlan *apnumber*

The command lists the VLANs to which the clients associated with the MAP are members, and whether traffic for each VLAN is locally switched or tunneled back to a WX switch.

The following command displays information about the VLANs switched by AP 7:

```
WX# display ap vlan 7
AP 7:
VLAN Name             Mode             Port    Tag
---- ---------------- ----- ----------------  ----
   1 default          local                1  none
   2 red local 1 2
                                    radio_1     20
                                    radio_1     21
                                    radio_2     22
   4 green             local              1       4
                                    radio_1      23
5    yellow            tunnel        wx_tun       5
                                    radio_1      24
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying ACL Information for a MAP

When a MAP is configured to perform local switching, you can display the number of packets filtered by security ACLs ("hits") on the MAP. Each time a packet is filtered by a security ACL, the MAP's ACL hit counter increments. To display ACL hits for a MAP, use the following command:

```
display ap acl hits ap-number
```

For MSS to count hits for a security ACL, you must specify **hits** in the **set security acl** commands that define ACE rules for the ACL.

The following command displays the security ACL hits on MAP 7,

```
WX# display ap acl hits 7
ACL hit-counters for AP 7
Index Counter              ACL-name
----- -------------------- --------
    1                    0 acl_2
    2                    0 acl_175
    3                  916 acl_123
```

To display a summary of the security ACLs that are mapped on a MAP, use the following command:

```
display ap acl map ap-number
```

This command lists only the ACLs that have been mapped on the specified MAP. To list all committed ACLs, use the **display security acl info** command. To list ACLs that have not yet been committed, use the **display security acl editbuffer** command.

To display a summary of the security ACLs mapped on MAP 7, type the following command:

```
WX# display ap acl map 7
ACL                          Type Class  Mapping
---------------------------- ---- ------ -------
acl_123                      IP   Static In
acl_133                      IP   Static In
acl_124                      IP   Static
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

11

CONFIGURING RF LOAD BALANCING FOR MAPS

This section describes the following configuration tasks:

- Disabling or re-enabling RF load balancing
- Assigning radios to load balancing groups
- Specifying band preference for RF load balancing
- Setting strictness for RF load balancing
- Exempting an SSID from RF load balancing

RF Load Balancing Overview

RF load balancing is the ability to reduce network congestion over an area by distributing client sessions across the MAP with overlapping coverage in the area. It allows you to provide the same client experience as if there were one nearby MAP with sufficient capacity, even when the total demand of nearby clients exceeds the capacity of a single MAP.

For example, in an auditorium or lecture hall, there may be a substantial number of clients in a relatively small amount of space. While a single MAP may be sufficient for providing an RF signal to the entire area, more MAPs are required in order to deliver enough aggregate bandwidth for all of the clients. When additional MAPs are installed in the room, RF load balancing allows the client sessions to be spread evenly across the MAPs, increasing the available aggregate bandwidth by increasing the number of MAPs.

RF load balancing is enabled by default. In addition, RF load balancing is done on a per-radio basis, rather than a per-MAP basis. For radios that are managed by a given radio profile, MSS automatically assesses which radios have overlapping coverage in an area and balances the client load across them.

MSS balances the client load by adjusting how MAPs are perceived by clients. As the relative capacity of a MAP handling new clients falls relative to other MAPs in the area, MSS makes the MAP more difficult for potential new clients to detect, which causes a client to associate with a MAP with more capacity. Note that by default MSS prevents clients from associating with a MAP only if there are other MAPs with available capacity in the area; clients are not prevented from associating with a MAP if it is the only one available.

You can optionally place MAP radios into load balancing groups. When two or more MAP radios are placed in the same load balancing group, MSS assumes that they have exactly the same coverage area, and attempts to distribute the client load across them equally. The MAP radios do not have to be on the same WX switch. A balanced set of MAP radios can span multiple WX switches in a Mobility Domain.

Configuring RF Load Balancing

This section describes the following configuration tasks:

- Disabling or re-enabling RF load balancing
- Assigning radios to load balancing groups
- Specifying band preference for RF load balancing
- Setting strictness for RF load balancing
- Exempting an SSID from RF load balancing

Disabling or Re-Enabling RF Load Balancing

RF load balancing is enabled by default globally on the WX switch and for individual radios. You can disable or enable it globally by using the following command:

```
set load-balancing mode {enable | disable}
```

To disable or enable RF load balancing for an individual radio, use the following command:

```
set ap apnumber radio radio-num load-balancing {enable |
disable}
```

If RF load balancing has been enabled or disabled for a specific MAP radio, then the setting for the individual radio takes precedence over the global setting.

Assigning Radios to Load Balancing Groups

Assigning radios to specific load balancing groups is optional. When you do this, MSS considers them to have exactly overlapping coverage areas, rather than using signal strength calculations to determine their overlapping coverage. MSS attempts to distribute client sessions across radios in the load balancing group evenly. A radio can be assigned to only one group.

To assign radios to load balancing groups, use the following command:

```
set ap ap-num radio radio-num load-balancing group name
[rebalance]
```

Use the **rebalance** parameter to configure the radio to disassociate its client sessions and rebalance them whenever a new radio is added to the load balancing group.

To remove a radio from its specified load balancing group, use the following command:

```
clear ap apnumber radio radio-num load-balancing group
```

Specifying Band Preference for RF Load Balancing

If a client supports both the 802.11a and 802.11b/g bands, you can configure MSS to steer the client to a less-busy radio on a MAP for the purpose of load balancing.

A global band-preference option controls the degree that a MAP with two radios attempts to conceal one of its radios from a client with the purpose of steering the client to the other radio.

Use the following command to cause clients that support both the 802.11a and 802.11b/g radio bands to be steered to a specific radio on the MAP for the purpose of load balancing:

```
set band-preference {none | 11bg | 11a}
```

Setting Strictness for RF Load Balancing

To perform RF load balancing, MSS makes MAP radios with heavy client loads less visible to new clients, causing them to associate with MAP radios that have a lighter load.

You can optionally specify how strictly MSS attempts to keep the client load balanced across the MAP radios in the load-balancing group. When low strictness is specified (the default), MSS makes heavily loaded MAP radios less visible in order to steer clients to less-busy MAP radios, but ensures that even if all the MAP radios in the group are heavily loaded, clients are not denied service.

At the other end of the spectrum, when maximum strictness is specified, if a MAP radio has reached its maximum client load, MSS makes it invisible to new clients, causing them to attempt to connect to other MAP radios. In the event that all the MAP radios in the group have reached their maximum client load, then no new clients would be able to connect to the network.

To specify how strictly MSS attempts to keep the client load balanced across the MAP radios in a load-balancing group, use the following command:

```
set load-balancing strictness {low | med | high | max}
```

- When the **low** option is set, no clients are denied service. New clients can be steered to other MAPs, but only to the extent that service can be provided to all clients. This is the default.
- When the **med** option is set, overloaded radios steer new clients to other MAPs more strictly than the **low** option. Clients attempting to connect to overloaded radios may be delayed several seconds.
- When the **high** option is set, overloaded radios steer new clients to other MAPs more strictly than the **med** option. Clients attempting to connect to overloaded radios may be delayed up to a minute.
- When the **max** option is set, RF load balancing is strictly enforced. That is, overloaded radios do not respond to new clients at all. A client would not be able to connect during times that all of the detectable MAP radios are overloaded.

Exempting an SSID from RF Load Balancing

By default, RF load balancing is applied to client sessions for all SSIDs. To specifically exempt an SSID from load balancing, use the following command:

```
set service-profile service-profile-name
load-balancing-exempt {enable | disable}
```

Exempting a service profile from RF load balancing means that even if a MAP radio is attempting to steer clients away, it does not reduce or conceal the availability of the SSID named in the exempted service profile. Even if a radio is withholding probe responses to manage its load, the radio does respond to probes for an exempt SSID. Also, if a MAP radio is withholding probe responses, and a client probes for *any* SSID, and the radio has at least one exempt SSID, the radio responds to the probe, but the response reveals only the exempt SSID(s).

Displaying RF Load Balancing Information

The **display load-balancing group** command displays a load balancing group member radios and current load for each radio. For example:

```
WX# display load-balancing group ap 2 radio 1
```

Radios in the same load-balancing group as: ap2/radio1

```
--------------------------------------------------
WX IP address Port Radio Overlap
------------------ ----- -------
```

For more information about the syntax, see the “MAP Commands” chapter of the *Wireless LAN Switch and Controller Command Reference*.

12 CONFIGURING WLAN MESH SERVICES

This section describes how to configure the WLAN mesh services.

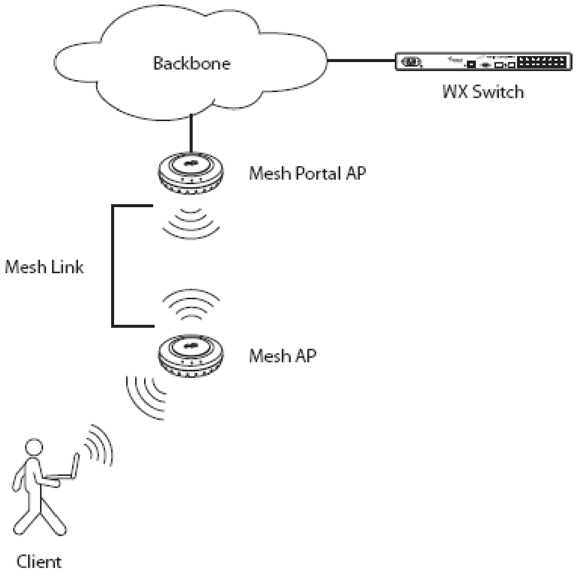
WLAN Mesh Services Overview

WLAN mesh services allow a MAP to provide wireless services to clients without having a wired interface on the MAP. Instead of a wired interface, there is a radio link to another MAP with a wired interface.

WLAN mesh services can be used at sites where running Ethernet cable to a location is inconvenient, expensive or impossible. Note that power must be available at the location where the Mesh AP is installed.

The following illustration shows how a client can connect to a network using WLAN mesh services.

Figure 18 WLAN Mesh Services



In the illustration, a client is associated with a *Mesh AP*, which is a MAP without a wired interface to the network. The Mesh AP is configured to communicate with a *Mesh Portal AP*, a MAP with wired connectivity to a WX switch.

Communication between the Mesh AP and the Mesh Portal AP takes place using over a secure radio link (a *Mesh Link*). When associated with the Mesh AP, the client has the same connectivity to the network as it has over a Mesh AP with a wired link.

The Mesh AP and Mesh Portal AP are dual-radio MAPs. One radio (for example, the 802.11a radio) can be used for Mesh Link communications, using an SSID reserved for this purpose, while the Mesh AP can use its other radio for client associations in the same manner as a non-Mesh AP.

The Mesh Portal AP beacons a mesh services SSID on the radio used for the Mesh Link. When the Mesh AP is booted, it searches for a MAP beaconing the mesh services SSID. It selects the Mesh Portal AP with the greatest signal strength, then establishes a secure connection to the Mesh Portal SSID. Once this connection is established, clients can associate with the Mesh AP.

WLAN mesh services is supported on MAP models MP-620 and MP-422 only.

Configuring WLAN Mesh Services

The basic configuration process for WLAN mesh services consists of the following tasks:

- Attaching the Mesh AP to the network and configuring mesh services.
- Configuring a service profile for mesh services.
- Setting security parameters to allow the Mesh AP to authenticate on the network.
- Optionally configuring the Mesh Portal AP to emit link calibration packets to aid in positioning the Mesh AP.
- Detaching the Mesh AP from the network and deploying it in its final location.

After the Mesh AP is installed in its final location, and it has established a connection to the Mesh Portal AP, it can be configured as any other MAP on the WX switch.

Configuring the Mesh AP

Before a Mesh AP can be installed in a location untethered from the network, it must be preconfigured for mesh services, including the mesh services SSID, and the pre-shared key that is used for establishing the connection between the Mesh AP and the Mesh Portal AP.

1. Attach the MAP to your network, apply power, and allow the MAP to boot as a regular MAP.
2. Once the MAP has booted, use the following command to enable mesh services on the MAP.

   ```
   set ap num boot-configuration mesh mode {enable | disable}
   ```

3. Use the following command to specify the pre-shared key:

   ```
   set ap num boot-configuration mesh {psk-phrase pass-phrase |
   psk-raw raw-pass}
   ```

   When a *pass-phrase* is specified, it is converted into a raw hexadecimal key and stored in the MAP boot configuration.

4. Use the following command to specify the mesh services SSID:

   ```
   set ap num boot-configuration mesh ssid mesh-ssid
   ```

   When the MAP is booted, and it determines that it has no Ethernet link to the network, it then associates with the specified *mesh-ssid*.

   Note that when the *mesh-ssid* is specified, the regulatory domain of the WX and the power restrictions are copied to the MAP flash memory. This prevents the Mesh AP from operating outside of regulatory limits after it is booted and before it receives its complete configuration from the WX switch.

   Consequently, it is important that the regulatory and antenna information specified on the WX switch actually reflects the locale where the Mesh AP is deployed, in order to avoid regulatory violations.

Configuring the Service Profile for Mesh Services

You configure the Mesh Portal AP to beacon the mesh services SSID. To do this, create a service profile and enable mesh services using the following commands:

```
set service-profile mesh-service-profile ssid-name mesh-ssid
set service-profile mesh-service-profile mesh mode {enable |
disable}
```

The service profile can then be mapped to a radio profile that manages a radio on the Mesh Portal MAP. Note that the radio profile to which the service profile is mapped cannot be configured to auto-tune power or channel settings.

Configuring Security

The secure connection between the Mesh AP and the Mesh Portal AP is established in a two-step process: creation of an encrypted point-to-point link between the Mesh AP, and the Mesh Portal AP, then authentication of the Mesh AP.

When the Mesh AP is booted, it searches for a beacon containing the configured mesh SSID. Once it locates a Mesh Portal AP with the mesh SSID, it associates with the Mesh Portal AP as a client device. The Mesh AP can then be authenticated by the WX switch.

To configure the Mesh AP to be authenticated, use the following commands:

```
set service-profile mesh-service-profile rsn-ie enable
set service-profile mesh-service-profile auth-psk enable
set service-profile mesh-service-profile cipher-ccmp enable
set service-profile mesh-service-profile cipher-tkip disable
set service-profile mesh-service-profile {psk-phrase
pass-phrase | psk-raw raw-pass}
set mac-user mesh-ap-mac-addr attr vlan-name default
set authentication mac ssid mesh-ssid * local
```

The *pass-phrase* or *raw-pass* is the same one configured on the Mesh AP. In addition, the Mesh AP must have its serial number and fingerprint configured on the WX switch.

Enabling Link Calibration Packets on the Mesh Portal MAP

A Mesh Portal MAP can be configured to emit *link calibration packets* to assist with positioning the Mesh AP. A link calibration packet is an unencrypted 802.11 management packet of type *Action*. When enabled on a MAP, link calibration packets are sent at a rate of 5 per second.

The MP-620 is equipped with a connector to which an external RSSI meter can be attached during installation. When an RSSI meter is attached to an MP-620 and a calibration packet is received, the MP-620 emits a voltage to the RSSI meter proportional to the received signal strength of the packet. This can aid in positioning the MP-620 where it has a strong signal to the Mesh Portal AP.

To enable link calibration packets on a MAP radio, use the following command:

```
set ap num radio num link-calibration mode {enable | disable}
```

Only one radio on a MAP can be configured to send link calibration packets. Link calibration packets are intended to be used only during installation of MAPs; they are not intended to be enabled on a continual basis.

Deploying the Mesh AP

After you have configured the Mesh AP with mesh services settings, detach the AP from the wired network and place it in the desired location. The Mesh Portal AP must be within radio range of the Mesh AP.

If the Mesh AP is an MP-620, you can configure the Mesh Portal AP to emit link calibration packets, then connect an RSSI meter to the RSSI connector on the MP-620. You can use the readings from the RSSI meter to gauge the strength of the signal from the Mesh Portal AP, and place the Mesh AP in a location with a strong signal.

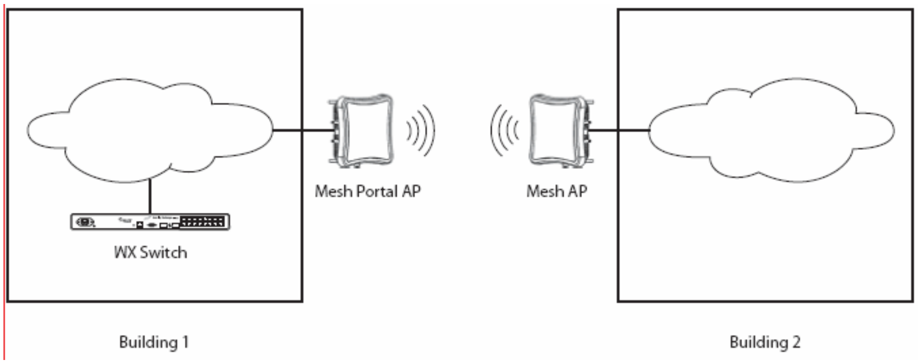
Configuring Wireless Bridging

You can use WLAN mesh services in a wireless bridge configuration, implementing MAPs as bridge endpoints in a transparent Layer 2 bridge.

Configuring a wireless bridge to connect two sites provides an alternative to installing Ethernet cable to provide bridge functionality.

A typical application of wireless bridging is to provide network connectivity between two buildings using a wireless link, as shown in the following illustration.

Figure 19 Wireless Bridging



The wireless bridge is established between a Mesh Portal AP and an associated Mesh AP. The bridged data packets are those present on the Ethernet interfaces of the two MAPs.

A Mesh Portal AP serving as a bridge endpoint can support up to five Mesh APs serving as bridge endpoints. A Mesh AP serving as a bridge endpoint picks up packets from its wired port and transfers them to the other bridge endpoint. A simple source/destination learning mechanism is used in order to avoid forwarding packets across the bridge unnecessarily.

To enable wireless bridging for a service profile, use the following command:

set service-profile *mesh-service-profile* **bridging** {**enable** | **disable**}

When wireless bridging is enabled for a service profile, the MAPs with the applied service profile serve as bridge peers. When a Mesh AP associates with a Mesh Portal AP through this service profile, the Mesh Portal AP automatically configures the Mesh AP to operate in bridge mode.

The **display service-profile** command indicates whether bridging has been enabled for the service profile.

Displaying WLAN Mesh Services Information

The **display ap status terse** command indicates which MAPs are Mesh APs and which are Mesh Portal MAPs. For example:

```
WX# display ap status terse
Total number of entries: 120
Operational: 1, Image Downloading: 0, Unknown: 119, Other: 0
Flags: o = operational, b = booting, d = image downloading
c = configuring, f = configuration failed
a = auto AP, m = mesh AP, p = mesh portal
i = insecure, e = encrypted, u = unencrypt
AP  Flag IP Address       Model      MAC Address       Radio1 Radio2 Uptime
--- ---- ---------------- ---------- ----------------- ------ ------ ------
7   om-u MP-422                      00:0b:0e:00:ca:c0 D 1/1  D56/1  19h47m
```

The **display ap status** command displays the mesh services attributes for a MAP and the associated BSSID of the Mesh Portal. For example:

```
WX# display ap status
AP: 1, IP-addr: 10.8.255.10 (vlan 'corp'), AP model: mp-422,
       manufacturer: 3Com, name: AP01
====================================================
State: operational (not encrypt)
CPU info: Atheros:MIPS32 speed=220000000 Hz version=AR5312, ram=16777216
                s/n=111111 hw_rev=n/a
Uptime: 0 hours, 0 minutes, 11 seconds
Uplink BSSID: 00:0b:0e:17:bb:00

Radio 1 type: 802.11g, state: configure succeed [Enabled] (802.11b protect)
      operational channel: 6 (Auto) operational power: 18
      bssid1: 00:0b:0e:fd:fd:cc, ssid: public
      RFID Reports: Inactive
      Antenna Link Calibration: Enabled
```

```
Radio 2 type: 802.11a, state: configure succeed [Enabled]
      operational channel: 36 operational power: 17
            bssid1: 00:0b:0e:fd:fd:cd, ssid: mesh-ssid (mesh)
```

The **display mesh links** command displays information about the links a MAP has to Mesh APs and Mesh Portal APs.

```
WX# display ap mesh-links 1
AP: 1 IP-addr: 1.1.1.3
Operational Mode: Mesh-Portal
Downlink Mesh-APs
-------------------------------------------------
BSSID: 00:0b:0e:17:bb:3f (54 Mbps)
           packets            bytes
TX:            307            44279
RX:            315           215046
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

13

CONFIGURING USER ENCRYPTION

Mobility System Software (MSS) encrypts wireless user traffic for all users who are successfully authenticated to join an encrypted SSID and who are then authorized to join a VLAN.

Overview

MSS supports the following types of encryption for wireless user traffic:

- 802.11i
- Wi-Fi Protected Access (WPA)
- WPA2 (Robust Security Network)
- Non-WPA dynamic Wired Equivalent Privacy (WEP)
- Non-WPA static WEP

WEP is described in the IEEE 802.11 standard and WPA is described in the 802.11i standard.

WPA and 802.11i provide stronger security than WEP. (802.11i uses *Robust Security Network (RSN)*, and is sometimes called *WPA2*.)

To use WPA or RSN, a client must support it. For non-WPA clients, MSS supports WEP. If your network contains a combination of WPA, RSN, clients and non-WPA clients, you can configure MSS to provide encryption for both types of clients.

To configure encryption parameters for an SSID, create or edit a service profile, map the service profile to a radio profile, and add radios to the radio profile. The SSID name, advertisement setting (beaconing), and encryption settings are configured in the service profile.

You can configure an SSID to support any combination of WPA, RSN, and non-WPA clients. For example, a radio can simultaneously use Temporal Key Integrity Protocol (TKIP) encryption for WPA clients and WEP encryption for non-WPA clients.

The SSID type must be crypto (encrypted) for encryption to be used. If the SSID type is clear, wireless traffic is not encrypted, regardless of the encryption settings.

MSS does not encrypt traffic in the wired part of the network. MSS does not encrypt wireless or wired traffic for users who associate with an unencrypted (clear) SSID.

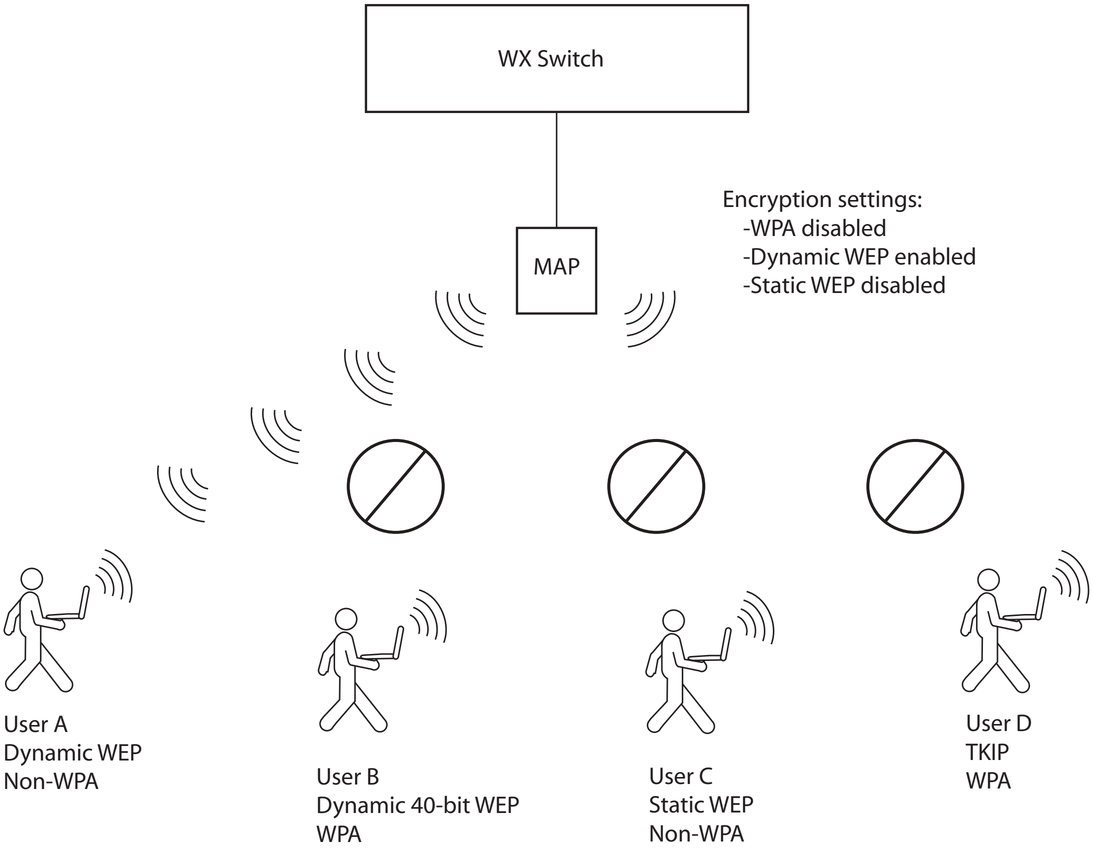
Table 23 lists the encryption types supported by MSS and their default states.

Table 23 Wireless Encryption Defaults

Encryption Type	Client Support	Default State	Configuration Required in MSS
RSN	RSN clients Non-RSN clients	Disabled	▪ Enable the RSN information element (IE). ▪ Specify the supported cipher suites (CCMP, TKIP, 40-bit WEP, 104-bit WEP). TKIP is enabled by default when the RSN IE is enabled.
WPA	WPA clients Non-WPA clients	Disabled	▪ Enable the WPA information element (IE). ▪ Specify the supported cipher suites (CCMP, TKIP, 40-bit WEP, 104-bit WEP). TKIP is enabled by default when the WPA IE is enabled.
Dynamic WEP	WEP clients (WPA and RSN not supported)	Enabled	None
Static WEP	WEP clients (WPA and RSN not supported)	Disabled	▪ Configure the static key(s). ▪ Assign keys to multicast and unicast traffic.

Figure 20 shows the client support when the default encryption settings are used. A radio using the default encryption settings encrypts traffic for non-WPA dynamic WEP clients but not for WPA clients or static WEP clients. The radio disassociates from these other clients.

Figure 20 Default Encryption


WX Switch
MAP
Encryption settings:
-WPA disabled
-Dynamic WEP enabled
-Static WEP disabled
User A
Dynamic WEP
Non-WPA
User B
Dynamic 40-bit WEP
WPA
User C
Static WEP
Non-WPA
User D
TKIP
WPA

This rest of this chapter describes the encryption types and how to configure them, and provides configuration scenarios.

Configuring WPA

Wi-Fi Protected Access (WPA) is a security enhancement to the IEEE 802.11 wireless standard. WPA provides enhanced encryption with new cipher suites and provides per-packet message integrity checks. WPA is based on the 802.11i standard. You can use WPA with 802.1X authentication. If the client does not support 802.1X, you can use a preshared key on the MAP and the client for authentication.

WPA Cipher Suites

WPA supports the following cipher suites for packet encryption, listed from most secure to least secure:

- **Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (CCMP)** — CCMP provides Advanced Encryption Standard (AES) data encryption. To provide message integrity, CCMP uses the Cipher Block Chaining Message Authentication Code (CBC-MAC).
- **Temporal Key Integrity Protocol (TKIP)** — TKIP uses the RC4 encryption algorithm, a 128-bit encryption key, a 48-bit initialization vector (IV), and a message integrity code (MIC) called Michael.
- **Wired Equivalent Privacy (WEP) with 104-bit keys** — 104-bit WEP uses the RC4 encryption algorithm with a 104-bit key.
- **WEP with 40-bit keys** — 40-bit WEP uses the RC4 encryption algorithm with a 40-bit key.

You can configure MAPs to support one or more of these cipher suites. For all of these cipher suites, MSS dynamically generates unique session keys for each session. MSS periodically changes the keys to reduce the likelihood that a network intruder can intercept enough frames to decode a key.

Figure 21 shows the client support when WPA encryption for TKIP only is enabled. A radio using WPA with TKIP encrypts traffic only for WPA TKIP clients but not for CCMP or WEP clients. The radio disassociates from these other clients.

Figure 21 WPA Encryption with TKIP Only

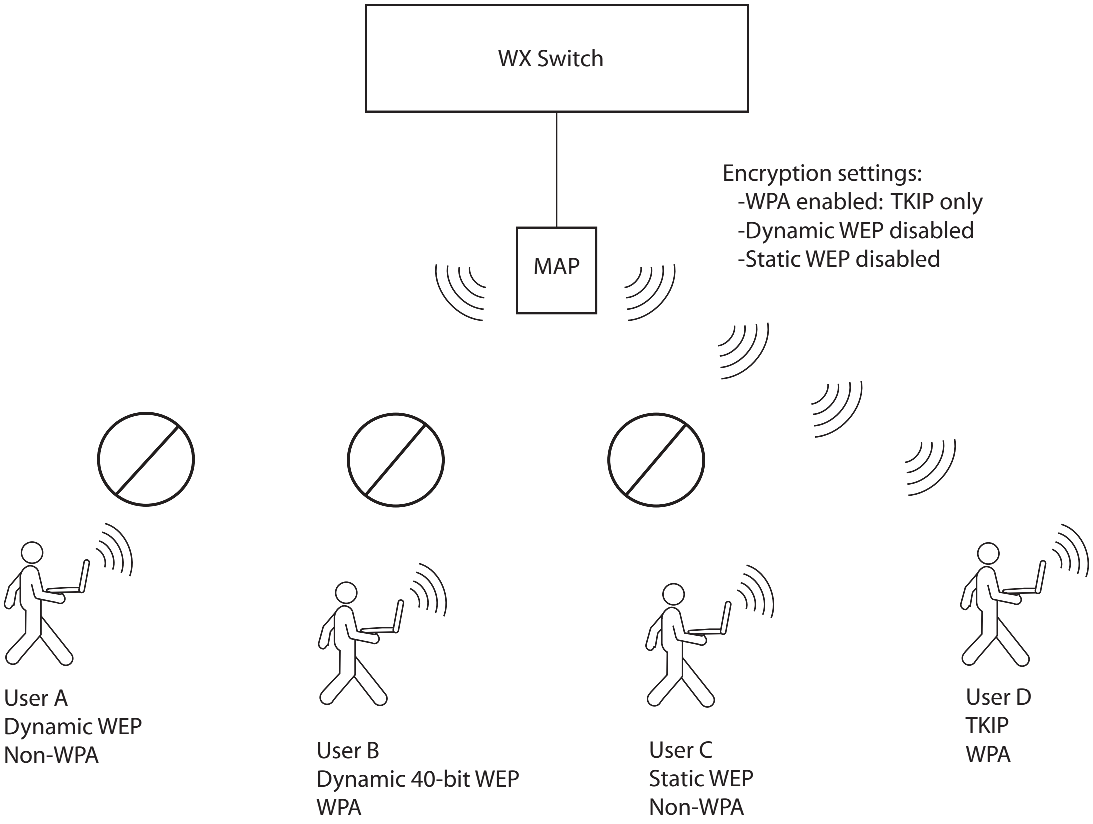
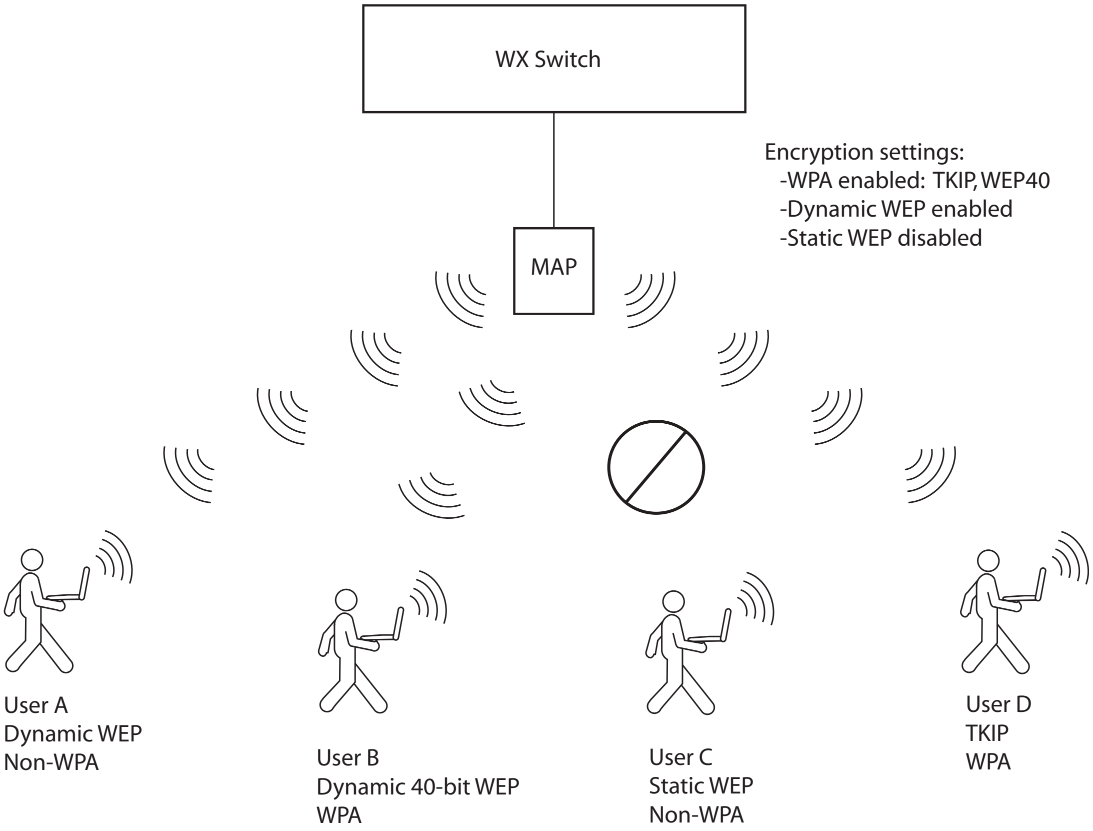

WX Switch
Encryption settings:
-WPA enabled: TKIP only
-Dynamic WEP disabled
-Static WEP disabled
MAP
User A
Dynamic WEP
Non-WPA
User B
Dynamic 40-bit WEP
WPA
User C
Static WEP
Non-WPA
User D
TKIP
WPA

Figure 22 shows the client support when both WEP encryption and TKIP are enabled. A radio using WPA with TKIP and WEP encrypts traffic for WPA TKIP clients, WPA WEP clients, *and* non-WPA dynamic WEP clients, but not for CCMP or static WEP clients. The radio disassociates from these other clients.

Figure 22 WPA Encryption with TKIP and WEP


WX Switch
Encryption settings:
-WPA enabled: TKIP, WEP40
-Dynamic WEP enabled
-Static WEP disabled
MAP
User A
Dynamic WEP
Non-WPA
User B
Dynamic 40-bit WEP
WPA
User C
Static WEP
Non-WPA
User D
TKIP
WPA

TKIP Countermeasures

WPA access points and clients verify the integrity of a wireless frame received on the network by generating a keyed message integrity check (MIC). The Michael MIC used with TKIP provides a holddown mechanism to protect the network against tampering.

- If the recalculated MIC matches the MIC received with the frame, the frame passes the integrity check and the access point or client processes the frame normally.
- If the recalculated MIC does not match the MIC received with the frame, the frame fails the integrity check. This condition is called a MIC failure. The access point or client discards the frame and also starts a 60-second timer. If another MIC failure does not occur within 60 seconds, the timer expires. However, if another MIC failure occurs before the timer expires, the device takes the following actions:
  - A MAP that receives another frame with an invalid MIC ends its sessions with all TKIP and WEP clients by disassociating from the clients. This includes both WPA WEP clients and non-WPA WEP clients. The access point also temporarily shuts down the network by refusing all association or reassociation requests from TKIP and WEP clients. In addition, MSS generates an SNMP trap that indicates the WX port and radio that received frames with the two MIC failures as well as the source and destination MAC addresses in the frames.
  - A client that receives another frame with an invalid MIC disassociates from its access point and does not send or accept any frames encrypted with TKIP or WEP.

  The MAP or client refuses to send or receive traffic encrypted with TKIP or WEP for the duration of the countermeasures timer, which is 60,000 milliseconds (60 seconds) by default. When the countermeasures timer expires, the access point allows associations and reassociations and generates new session keys for them. You can set the countermeasures timer for MAP radios to a value from 0 to 60,000 milliseconds (ms). If you specify 0 ms, the radios do not use countermeasures but instead continue to accept and forward encrypted traffic following a second MIC failure. However, MSS still generates an SNMP trap to inform you of the MIC failure.

The MIC used by CCMP, CBC-MAC, is even stronger than Michael and does not require or provide countermeasures. WEP does not use a MIC. Instead, WEP performs a cyclic redundancy check (CRC) on the frame and generates an integrity check value (ICV).

WPA Authentication Methods

You can configure an SSID to support one or both of the following authentication methods for WPA clients:

- **802.1X** — The MAP and client use an Extensible Authentication Protocol (EAP) method to authenticate one another, then use the resulting key in a handshake to derive a unique key for the session. The 802.1X authentication method requires user information to be configured on AAA servers or in the WX switch's local database. This is the default WPA authentication method.
- **Preshared key (PSK)** — A MAP radio and a client authenticate one another based on a key that is statically configured on both devices. The devices then use the key in a handshake to derive a unique key for the session. For a given service profile, you can globally configure a PSK for use with all clients. You can configure the key by entering an ASCII passphrase or by entering the key itself in raw (hexadecimal) form.

For a MAC client that authenticates using a PSK, the RADIUS servers or local database still must contain an authentication rule for the client, to assign the client to a VLAN.

MSS sets the timeout for the key exchanges between WPA (or RSN) clients and the MAP to the same value as the last setting of the retransmission timeout. The retransmission timeout is set to the lower of the 802.1X supplicant timeout or the RADIUS session-timeout attribute. See "Setting EAP Retransmission Attempts" on page 535 for more information.

WPA Information Element

A WPA information element (IE) is a set of extra fields in a wireless frame that contain WPA information for the access point or client. To enable WPA support in a service profile, you must enable the WPA IE. The following types of wireless frames can contain a WPA IE:

- **Beacon (sent by a MAP)** — The WPA IE in a beacon frame advertises the cipher suites and authentication methods that a MAP radio supports for the encrypted SSID. The WPA IE also lists the cipher suites that the radio uses to encrypt broadcast and multicast frames. A MAP radio always uses the least secure of the cipher suites to encrypt broadcast and multicast frames to ensure that all clients associated with the SSID can decrypt the frames. A MAP radio uses the most secure cipher suite supported by both the radio and a client to encrypt unicast traffic to that client.

- **Probe response (sent by a MAP radio)** — The WPA IE in a probe response frame lists the same WPA information that is contained in the beacon frame.
- **Association request or reassociation (sent by a client)** — The WPA IE in an association request lists the authentication method and cipher suite the client wants to use.

Client Support

To use the TKIP or CCMP cipher suite for encryption, a client must support WPA. However, a MAP radio configured for WPA can support non-WPA clients who use dynamic WEP or static WEP. If the WPA IE is enabled in the service profile used by an SSID supported by the radio, and the 40-bit WEP or 104-bit WEP cipher suite also is enabled in the service profile, MSS allows a non-WPA client to authenticate using WEP under the following circumstances:

- If a client wants to authenticate using dynamic WEP, MSS uses 802.1X to authenticate the client if either the WEP40 or WEP104 cipher suite is enabled for WPA.
- If a client wants to authenticate using static WEP, the radio checks for the static WEP key presented by the client. If the keys match, MSS authenticates the client. Because the WEP key is static, MSS does not use 802.1X to authenticate the client.

To allow a non-WPA client that uses dynamic WEP to be authenticated by a radio on which WPA IE is enabled, enable the WEP40 or WEP104 cipher suite in the service profile for the SSID the client will access. To prevent non-WPA clients that use dynamic WEP from being authenticated, do not enable the WEP40 or WEP104 cipher suite in the service profile.

To allow a client that uses static WEP to be authenticated, configure the same WEP keys on the client and the service profile.

Table 24 lists the encryption support for WPA and non-WPA clients.

Table 24 Encryption Support for WPA and Non-WPA Clients

MSS Encryption Type	**Client Encryption Type**					
	WPA — CCMP	**WPA — TKIP**	**WPA — WEP40**	**WPA — WEP104**	**Dynamic WEP**	**Static WEP**
WPA — CCMP	Supports					
WPA — TKIP		Supports				
WPA — WEP40			Supports		Supports	
WPA — WEP104				Supports	Supports	Supports
Dynamic WEP					Supports	
Static WEP						Supports

Configuring WPA

To configure MAP radios to support WPA:

1. Create a service profile for each SSID that will support WPA clients.
2. Enable the WPA IE in the service profile.
3. Enable the cipher suites you want to support in the service profile. (TKIP is enabled by default.) Optionally, you also can change the countermeasures timer value for TKIP.
4. Map the service profile to the radio profile that will control IEEE settings for the radios.
5. Assign the radio profile to the radios and enable the radios.

If you plan to use PSK authentication, you also need to enable this authentication method and enter an ASCII passphrase or a hexadecimal (raw) key.

Creating a Service Profile for WPA

Encryption parameters apply to all users who use the SSID configured by a service profile. To create a service profile, use the following command:

```
set service-profile name
```

To create a new service profile named *wpa*, type the following command:

```
WX1200# set service-profile wpa
success: change accepted.
```

Enabling WPA

To enable WPA, you must enable the WPA information element (IE) in the service profile. To enable the WPA IE, use the following command:

```
set service-profile name wpa-ie {enable | disable}
```

To enable WPA in service profile *wpa*, type the following command:

```
WX1200# set service-profile wpa wpa-ie enable
success: change accepted.
```

Specifying the WPA Cipher Suites

To use WPA, at least one cipher suite must be enabled. You can enable one or more of the following cipher suites:

- CCMP
- TKIP
- 40-bit WEP
- 104-bit WEP

By default, TKIP is enabled and the other cipher suites are disabled.

To enable or disable cipher suites, use the following commands:

```
set service-profile name cipher-ccmp {enable | disable}
set service-profile name cipher-tkip {enable | disable}
set service-profile name cipher-wep104 {enable | disable}
set service-profile name cipher-wep40 {enable | disable}
```

To enable the 40-bit WEP cipher suite in service profile *wpa*, type the following command:

```
WX1200# set service-profile wpa cipher-wep40 enable
success: change accepted.
```

After you type this command, the service profile supports TKIP and 40-bit WEP.

Microsoft Windows XP does not support WEP with WPA. To configure a service profile to provide WEP for XP clients, leave WPA disabled and see "Configuring WEP" on page 299.

Changing the TKIP Countermeasures Timer Value

By default, MSS enforces TKIP countermeasures for 60,000 ms (60 seconds) after a second MIC failure within a one-minute interval. To change the countermeasures timer value, use the following command:

```
set service-profile name tkip-mc-time wait-time
```

To change the countermeasures wait time in service profile *wpa* to 30 seconds, type the following command:

```
WX1200# set service-profile wpa tkip-mc-time 30000
success: change accepted.
```

Enabling PSK Authentication

By default, WPA uses 802.1X dynamic keying. If you plan to use static keys, you must enable PSK authentication and configure a passphrase or the raw key. You can configure the passphrase or key globally. You also can configure keys on an individual MAC client basis.

By default, 802.1X authentication remains enabled when you enable PSK authentication.

To enable PSK authentication, use the following command:

```
set service-profile name auth-psk {enable | disable}
```

To enable PSK authentication in service profile *wpa*, type the following command:

```
WX1200# set service-profile wpa auth-psk enable
success: change accepted.
```

Configuring a Global PSK Passphrase or Raw Key for All Clients

To configure a global passphrase for all WPA clients, use the following command:

```
set service-profile name psk-phrase passphrase
```

The passphrase must be from 8 to 63 characters long, including blanks. If you use blanks, you must enclose the string in quotation marks.

To configure service profile *wpa* to use passphrase *1234567890123<>?=+&% The quick brown fox jumps over the lazy sl*, type the following command:

```
WX1200# set service-profile wpa psk-phrase "1234567890123<>
?=+&% The quick brown fox jumps over the lazy sl"
success: change accepted.
```

As an alternative to entering a passphrase, which MSS converts into a key, you can enter the key itself in raw hexadecimal format. To enter a PSK key in raw format, use the following command:

```
set service-profile name psk-raw hex
```

For *hex*, type a 64-bit ASCII string representing a 32-digit hexadecimal number. Enter the two-character ASCII form of each hexadecimal number.

To configure service profile *wpa* to use a raw PSK with PSK clients, type a command such as the following:

```
WX1200# set service-profile wpa psk-raw c25d3fe4483e867d1df96
eaacdf8b02451fa0836162e758100f5f6b87965e59d
success: change accepted.
```

Disabling 802.1X Authentication for WPA

To disable 802.1X authentication for WPA clients, use the following command:

```
set service-profile name auth-dot1x {enable | disable}
```

This command does not disable 802.1X authentication for non-WPA clients.

To disable WPA authentication in service profile *wpa*, type the following command:

```
WX1200# set service-profile wpa auth-dot1x disable
success: change accepted.
```

Displaying WPA Settings

To display the WPA settings in a service profile, use the following command:

```
display service-profile {name | ?}
```

To display the WPA settings in effect in service profile *wpa*, type the following command:

```
WX1200# display service-profile sp1
ssid-name:                     private   ssid-type:                      crypto
Beacon:                            yes   Proxy ARP:                          no
DHCP restrict:                      no   No broadcast:                       no
Short retry limit:                   5   Long retry limit:                    5
Auth fallthru:                    none   Sygate On-Demand (SODA):            no
Enforce SODA checks:               yes   SODA remediation ACL:
Custom success web-page:                 Custom failure web-page:
Custom logout web-page:                  Custom agent-directory:
Static COS:                         no   COS:                                 0
CAC mode:                         none   CAC sessions:                       14
User idle timeout:                 180   Idle client probing:               yes
Keep initial vlan:                  no   Web Portal Session Timeout:          5
Web Portal ACL:
WEP Key 1 value:                <none>   WEP Key 2 value:                <none>
WEP Key 3 value:                <none>   WEP Key 4 value:                <none>
WEP Unicast Index:                   1   WEP Multicast Index:                 1
Shared Key Auth:                    NO
WPA enabled:
    ciphers: cipher-tkip, cipher-wep40
    authentication: 802.1X
    TKIP countermeasures time: 30000ms
11a beacon rate:                   6.0   multicast rate:                   AUTO
11a mandatory rate: 6.0,12.0,24.0 standard rates: 9.0,18.0,36.0,48.0,54.0
11b beacon rate:                   2.0   multicast rate:                   AUTO
11b mandatory rate: 1.0,2.0 standard rates: 5.5,11.0
11g beacon rate:                   2.0   multicast rate:                   AUTO
11g mandatory rate: 1.0,2.0,5.5,11.0 standard rates: 6.0,9.0,12.0,18.0,24.0,
36.0,48.0,54.0
```

The WPA settings appear at the bottom of the output.

The WPA fields appear in the ***display service-profile*** *output only when WPA is enabled.*

Assigning the Service Profile to Radios and Enabling the Radios

After you configure WPA settings in a service profile, you can map the service profile to a radio profile, assign the radio profile to radios, and enable the radios to activate the settings.

To map a service profile to a radio profile, use the following command:

```
set radio-profile name service-profile name
```

To assign a radio profile to radios and enable the radios, use the following command:

```
set ap port-list radio {1 | 2} radio-profile name
mode {enable | disable}
```

To map service profile *wpa* to radio profile *bldg1*, type the following command:

```
WX1200# set radio-profile blgd1 service-profile wpa
success: change accepted.
```

To assign radio profile *bldg1* to radio 1 on ports 1-3, and 5 and enable the radios, type the following command:

```
WX1200# set ap 1-3,5 radio 1 radio-profile bldg1 mode enable
success: change accepted.
```

To assign radio profile *bldg1* to radio 2 on ports 1-2 and port 6 and enable the radios, type the following command:

```
WX1200# set ap 1-2,6 radio 2 radio-profile bldg1 mode enable
success: change accepted.
```

Configuring RSN (802.11i)

Robust Security Network (RSN) provides 802.11i support. RSN uses AES encryption.

You can configure a service profile to support RSN clients exclusively, or to support RSN with WPA clients, or even RSN, WPA and WEP clients.

The configuration tasks for a service profile to use RSN are similar to the tasks for WPA:

1. Create a service profile for each SSID that will support RSN clients.
2. Enable the RSN IE in the service profile.
3. Enable the cipher suites you want to support in the service profile. (TKIP is enabled by default.) Optionally, you also can change the countermeasures timer value for TKIP.
4. Map the service profile to the radio profile that will control IEEE settings for the radios.
5. Assign the radio profile to the radios and enable the radios.

If you plan to use PSK authentication, you also need to enable this authentication method and enter an ASCII passphrase or a hexadecimal (raw) key.

Creating a Service Profile for RSN

Encryption parameters apply to all users who use the SSID configured by a service profile. To create a service profile, use the following command:

```
set service-profile name
```

To create a new service profile named *rsn*, type the following command:

```
WX1200# set service-profile rsn
success: change accepted.
```

Enabling RSN

To enable RSN, you must enable the RSN information element (IE) in the service profile. To enable the RSN IE, use the following command:

```
set service-profile name rsn-ie {enable | disable}
```

To enable RSN in service profile *wpa*, type the following command:

```
WX1200# set service-profile rsn rsn-ie enable
success: change accepted.
```

Specifying the RSN Cipher Suites

To use RSN, at least one cipher suite must be enabled. You can enable one or more of the following cipher suites:

- CCMP
- TKIP
- 40-bit WEP
- 104-bit WEP

By default, TKIP is enabled and the other cipher suites are disabled.

To enable or disable cipher suites, use the following commands:

```
set service-profile name cipher-ccmp {enable | disable}
set service-profile name cipher-tkip {enable | disable}
set service-profile name cipher-wep104 {enable | disable}
set service-profile name cipher-wep40 {enable | disable}
```

To enable the CCMP cipher suite in service profile *rsn*, type the following command:

```
WX1200# set service-profile rsn cipher-ccmp enable
success: change accepted.
```

After you type this command, the service profile supports both TKIP and CCMP.

Microsoft Windows XP does not support WEP with RSN. To configure a service profile to provide WEP for XP clients, leave RSN disabled and see "Configuring WEP" on page 299.

Changing the TKIP Countermeasures Timer Value

To change the TKIP countermeasures timer, see "Changing the TKIP Countermeasures Timer Value" on page 298. The procedure is the same for WPA and RSN.

Enabling PSK Authentication

To enable PSK authentication, see "Enabling PSK Authentication" on page 298. The procedure is the same for WPA and RSN.

Displaying RSN Settings

To display the RSN settings in a service profile, use the following command:

```
display service-profile {name | ?}
```

The RSN settings appear at the bottom of the output.

*RSN-related fields appear in the **display service-profile** output only when RSN is enabled.*

Assigning the Service Profile to Radios and Enabling the Radios

After you configure RSN settings in a service profile, you can map the service profile to a radio profile, assign the radio profile to radios, and enable the radios to activate the settings.

To map a service profile to a radio profile, use the following command:

```
set radio-profile name service-profile name
```

To assign a radio profile to radios and enable the radios, use the following command:

```
set ap port-list radio {1 | 2} radio-profile name
mode {enable | disable}
```

To map service profile *rsn* to radio profile *bldg2*, type the following command:

```
WX1200# set radio-profile blgd2 service-profile rsn
success: change accepted.
```

Configuring WEP

Wired-Equivalent Privacy (WEP) is a security protocol defined in the 802.11 standard. WEP uses the RC4 encryption algorithm to encrypt data.

To provide integrity checking, WEP access points and clients check the integrity of a frame's cyclic redundancy check (CRC), generate an integrity check value (ICV), and append the value to the frame before sending it. The radio or client that receives the frame recalculates the ICV and compares the result to the ICV in the frame. If the values match, the frame is processed. If the values do not match, the frame is discarded.

WEP is either dynamic or static depending on how the encryption keys are generated. MAPs support dynamic WEP and static WEP.

- For dynamic WEP, MSS dynamically generates keys for broadcast, multicast, and unicast traffic. MSS generates unique unicast keys for each client session and periodically regenerates (rotates) the broadcast and multicast keys for all clients. You can change or disable the broadcast or multicast rekeying interval.
- For static WEP, MSS uses statically configured keys typed in the WX switch's configuration and on the wireless client and does not rotate the keys.

Dynamic WEP encryption is enabled by default. You can disable dynamic WEP support by enabling WPA and leaving the WEP-40 or WEP-104 cipher suites disabled. If you use dynamic WEP, 802.1X must also be configured on the client in addition to WEP.

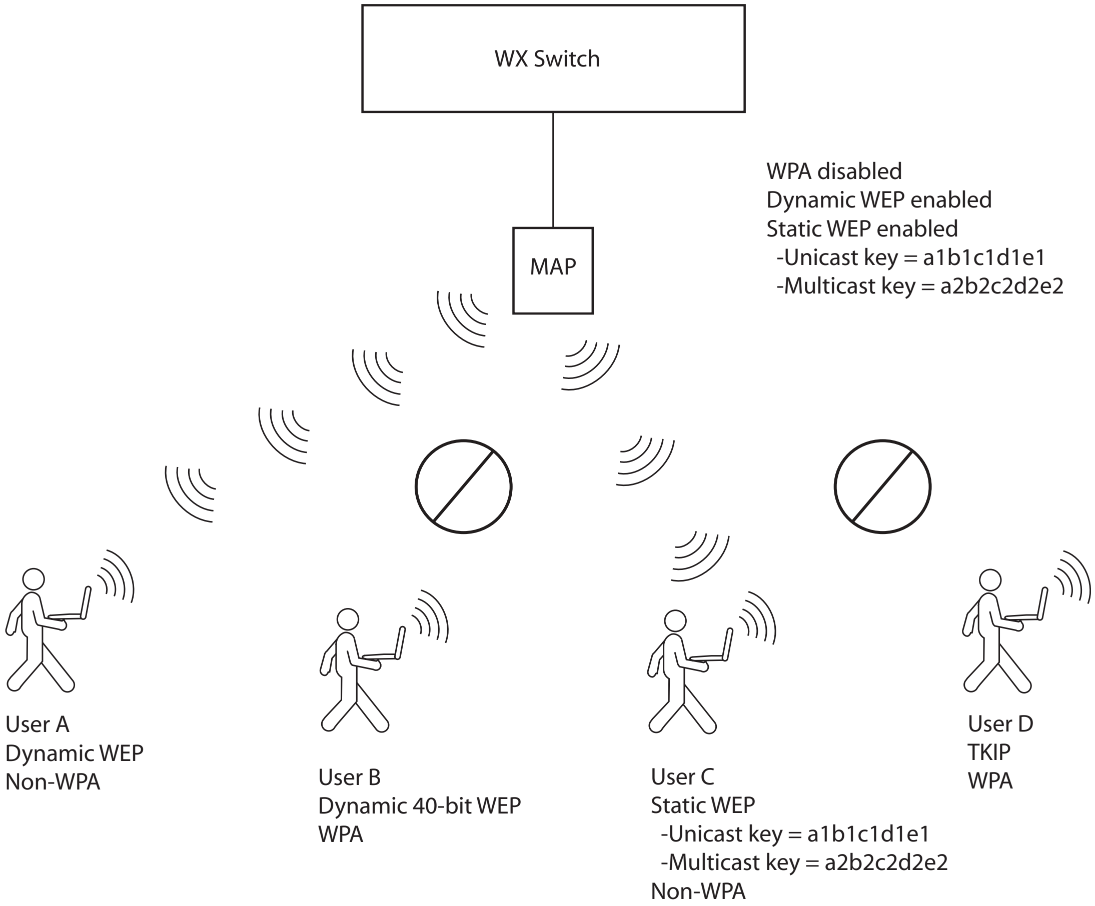
Static WEP encryption is disabled by default. To enable static WEP encryption, configure the static WEP keys and assign them to unicast and multicast traffic. Make sure you configure the same static keys on the clients.

To support dynamic WEP in a WPA environment, enable WPA and enable the WEP-40 or WEP-104 cipher suite. (See "Configuring WPA" on page 290.)

This section describes how to configure and assign static WEP keys. (To change other key-related settings, see "Managing 802.1X Encryption Keys" on page 533.)

Figure 23 shows an example of a radio configured to provide static and dynamic WEP encryption for non-WPA clients. The radio uses dynamically generated keys to encrypt traffic for dynamic WEP clients. The radio also encrypts traffic for static WEP clients whose keys match the keys configured on the radio.

Figure 23 Encryption for Dynamic and Static WEP


WX Switch
MAP
WPA disabled
Dynamic WEP enabled
Static WEP enabled
-Unicast key = a1b1c1d1e1
-Multicast key = a2b2c2d2e2
User A
Dynamic WEP
Non-WPA
User B
Dynamic 40-bit WEP
WPA
User C
Static WEP
-Unicast key = a1b1c1d1e1
-Multicast key = a2b2c2d2e2
Non-WPA
User D
TKIP
WPA

Setting Static WEP Key Values

MSS supports dynamic WEP automatically. To enable static WEP, configure WEP keys and assign them to unicast and multicast traffic. You can set the values of the four static WEP keys, then specify which of the keys to use for encrypting multicast frames and unicast frames. If you do this, MSS continues to support dynamic WEP in addition to static WEP.

To set the value of a WEP key, use the following command:

```
set service-profile name wep key-index num key value
```

The **key-index** *num* parameter specifies the index you are configuring. You can specify a value from 1 through 4.

The **key** *value* parameter specifies the hexadecimal value of the key. Type a 10-character ASCII string (representing a 5-byte hexadecimal number) or type a 26-character ASCII string (representing a 13-byte hexadecimal number). You can use numbers or letters. ASCII characters in the following ranges are supported:

- 0 to 9
- A to F
- a to f

To configure WEP key index 1 for radio profile *rp1* to *aabbccddee*, type the following command:

```
WX1200# set service-profile rp1 wep key-index 1 key
aabbccddee
success: change accepted.
```

Assigning Static WEP Keys

When static WEP is enabled, static WEP key 1 is assigned to unicast and multicast traffic by default. To assign another key to unicast or multicast traffic, use the following commands:

```
set service-profile name wep active-multicast-index num
set service-profile name wep active-unicast-index num
```

The *num* parameter specifies the key and the value can be from 1 to 4.

To configure an SSID that uses service profile *wepsrvc* to use WEP key index 2 for encrypting multicast traffic, type the following command:

```
WX1200# set service-profile wepsrvc wep
active-multicast-index 2
success: change accepted.
```

To configure an SSID that uses service profile *wepsrvc4* to use WEP key index 4 for encrypting unicast traffic, type the following command:

```
WX1200# set service-profile wepsrvc4 wep
active-unicast-index 4
success: change accepted.
```

Encryption Configuration Scenarios

The following scenarios provide examples of ways in which you can configure encryption for network clients:

- "Enabling WPA with TKIP" on page 302
- "Enabling Dynamic WEP in a WPA Network" on page 304
- "Configuring Encryption for MAC Clients" on page 306

Enabling WPA with TKIP

The following example shows how to configure MSS to provide authentication and TKIP encryption for 801.X WPA clients. This example assumes that pass-through authentication is used for all users. A RADIUS server group performs all authentication and authorization for the users.

1. Create an authentication rule that sends all 802.1X users of SSID *mycorp* in the *EXAMPLE* domain to the server group *shorebirds* for authentication. Type the following command:

```
WX1200# set authentication dot1x ssid mycorp EXAMPLE\*
pass-through shorebirds
```

2. Create a service profile named *wpa* for the SSID. Type the following command:

```
WX1200# set service-profile wpa
success: change accepted.
```

3. Set the SSID in the service profile to *mycorp*. Type the following command:

```
WX1200# set service-profile wpa ssid-name wpa
success: change accepted.
```

4. Enable WPA in service profile *wpa*. Type the following command:

```
WX1200# set service-profile wpa wpa-ie enable
success: change accepted.
```

TKIP is already enabled by default when WPA is enabled.

5. Display the service profile *wpa* to verify the changes. Type the following command:

```
WX1200# display service-profile sp1
ssid-name:                     mycorp   ssid-type:                    crypto
Beacon:                           yes   Proxy ARP:                        no
DHCP restrict:                     no   No broadcast:                     no
Short retry limit:                  5   Long retry limit:                  5
Auth fallthru:                   none   Sygate On-Demand (SODA):          no
Enforce SODA checks:              yes   SODA remediation ACL:
Custom success web-page:                Custom failure web-page:
Custom logout web-page:                 Custom agent-directory:
Static COS:                        no   COS:                               0
CAC mode:                        none   CAC sessions:                     14
User idle timeout:                180   Idle client probing:             yes
Keep initial vlan:                 no   Web Portal Session Timeout:        5
Web Portal ACL:
Web Portal Session Timeout:         5
WEP Key 1 value:               <none>   WEP Key 2 value:              <none>
WEP Key 3 value:               <none>   WEP Key 4 value:              <none>
WEP Unicast Index:                  1   WEP Multicast Index:               1
Shared Key Auth:                   NO
WPA enabled:
    ciphers: cipher-tkip
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
...
```

6 Map service profile *wpa* to radio profile *rp1*. Type the following commands:

```
WX1200# set radio-profile rp1 service-profile wpa
success: change accepted.
```

7 Apply radio profile *rp1* to radio 1 on port 5 and to radios 1 and 2 on port 6, enable the radios, and verify the configuration changes. Type the following commands:

```
WX1200# set ap 5,6 radio 1 radio-profile rp1 mode enable
success: change accepted.
WX1200# set ap 6 radio 2 radio-profile rp1 mode enable
success: change accepted.
```

```
WX1200# display ap config
Port  5: AP model: mp-241, POE:  enable, bias: high, name: MAP05
           boot-download-enable: YES
           force-image download: YES
  Radio 1: type: 802.11a, mode:  enabled, channel: 36
  tx pwr:  1, profile: rp1
  auto-tune max-power: default
Port  11: AP model: mp-252, POE:  enable, bias: high, name: MAP11
           boot-download-enable: YES
```

```
        force-image download: YES
Radio 1: type: 802.11g, mode:  enabled, channel: 6
tx pwr:  1, profile: rp1
auto-tune max-power: default
Radio 2: type: 802.11a, mode: enabled, channel: 36
tx pwr:  1, profile: rp1
auto-tune max-power: default
```

8 Save the configuration. Type the following command:

```
WX1200# save config
success: configuration saved.
```

Enabling Dynamic WEP in a WPA Network

The following example shows how to configure MSS to provide authentication and encryption for 801.X dynamic WEP clients, and for 801.X WPA clients using TKIP. This example assumes that pass-through authentication is used for all users. The commands are the same as those in "Enabling WPA with TKIP" on page 302, with the addition of a command to enable a WEP cipher suite. The WEP cipher suite allows authentication and encryption for both WPA and non-WPA clients that want to authenticate using dynamic WEP.

1 Create an authentication rule that sends all 802.1X users of SSID *mycorp* in the *EXAMPLE* domain to the server group *shorebirds* for authentication. Type the following command:

```
WX1200# set authentication dot1x ssid thiscorp EXAMPLE\*
pass-through shorebirds
```

2 Create a service profile named *wpa-wep* for the SSID. Type the following command:

```
WX1200# set service-profile wpa-wep
success: change accepted.
```

3 Set the SSID in the service profile to *thiscorp*. Type the following command:

```
WX1200# set service-profile wpa-wep ssid-name thiscorp
success: change accepted.
```

4 Enable WPA in service profile *wpa-wep*. Type the following command:

```
WX1200# set service-profile wpa-wep wpa-ie enable
success: change accepted.
```

5 Enable the WEP40 cipher suite in service profile *wpa-wep*. Type the following command:

```
WX1200# set service-profile wpa-wep cipher-wep40 enable
success: change accepted.
```

TKIP is already enabled by default when WPA is enabled.

6 Display the service profile *wpa-wep* to verify the changes. Type the following command:

```
WX1200# display service-profile sp1
ssid-name:                    mycorp   ssid-type:                       crypto
Beacon:                          yes   Proxy ARP:                           no
DHCP restrict:                    no   No broadcast:                        no
Short retry limit:                 5   Long retry limit:                     5
Auth fallthru:                  none   Sygate On-Demand (SODA):             no
Enforce SODA checks:             yes   SODA remediation ACL:
Custom success web-page:               Custom failure web-page:
Custom logout web-page:                Custom agent-directory:
Static COS:                       no   COS:                                  0
CAC mode:                       none   CAC sessions:                        14
User idle timeout:               180   Idle client probing:                yes
Keep initial vlan:                no   Web Portal Session Timeout:           5
Web Portal ACL:
WEP Key 1 value:              <none>   WEP Key 2 value:                 <none>
WEP Key 3 value:              <none>   WEP Key 4 value:                 <none>
WEP Unicast Index:                 1   WEP Multicast Index:                  1
Shared Key Auth:                  NO
WPA enabled:
    ciphers: cipher-tkip, cipher-wep40
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
...
```

7 Map service profile *wpa-wep* to radio profile *rp2*. Type the following commands:

```
WX1200# set radio-profile rp2 service-profile wpa-wep
success: change accepted.
```

8 Apply radio profile *rp2* to radio 1 on port 5 and to radios 1 and 2 on port 6, enable the radios, and verify the configuration changes. Type the following commands:

```
WX1200# set ap 5,6 radio 1 radio-profile rp2 mode enable
success: change accepted.
WX1200# set ap 6 radio 2 radio-profile rp2 mode enable
success: change accepted.
```

```
WX1200# display ap config
Port 5: AP model: mp-241, POE:  enable, bias: high, name: MAP05
           boot-download-enable: YES
           force-image-download: YES
  Radio 1: type: 802.11a, mode:  enabled, channel: 36
  tx pwr:  1, profile: rp2
  auto-tune max-power: default
Port  6: AP model: mp-252, POE:  enable, bias: high, name: MAP11
           boot-download-enable: YES
           force-image-download: YES
  Radio 1: type: 802.11g, mode:  enabled, channel: 6
  tx pwr:  1, profile: rp2
  auto-tune max-power: default
Port 11: AP model: mp-252, POE: enable, bias: high, name: MP11
            boot-download-enable: YES
            force-image-download: YES
Radio 1: type: 802.11g, mode: enabled, channel: 6
tx pwr: 1, profile: rp2
auto-tune max-power: default
Radio 2: type: 802.11a, mode: enabled, channel: 36
tx pwr: 1, profile: rp2
auto-tune max-power: default
```

9 Save the configuration. Type the following command:

```
WX1200# save config
success: configuration saved.
```

Configuring Encryption for MAC Clients

The following example shows how to configure MSS to provide PSK authentication and TKIP or 40-bit WEP encryption for MAC clients:

1 Create an authentication rule that sends all MAC users of SSID *voice* to the local database for authentication and authorization. Type the following command:

```
WX1200# set authentication mac ssid voice * local
success: configuration saved.
```

2 Configure a MAC user group named *wpa-for-mac* that assigns all MAC users in the group to VLAN *blue*. Type the following command:

```
WX1200# set mac-usergroup wpa-for-mac attr vlan-name blue
success: configuration saved.
```

3 Add MAC users to MAC user group *wpa-for-mac*. Type the following commands:

```
WX1200# set mac-user aa:bb:cc:dd:ee:ff group wpa-for-mac
success: configuration saved.
WX1200# set mac-user a1:b1:c1:d1:e1:f1 group wpa-for-mac
success: configuration saved.
```

4 Verify the AAA configuration changes. Type the following command:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=0 key=(null) author-pass=(null)

Radius Servers
Server                  Addr           Ports   T/o Tries Dead State
-------------------------------------------------------------------
Server groups
set authentication mac ssid voice * local
mac-usergroup wpa-for-mac
   vlan-name = blue

mac-user aa:bb:cc:dd:ee:ff
   Group = wpa-for-mac

mac-user a1:b1:c1:d1:e1:f1
   Group = wpa-for-mac
```

5 Create a service profile named *wpa-wep-for-mac* for SSID voice. Type the following command:

```
WX1200# set service-profile wpa-wep-for-mac
success: change accepted.
```

6 Set the SSID in the service profile to *voice*. Type the following command:

```
WX1200# set service-profile wpa-wep-for-mac ssid-name voice
success: change accepted.
```

7 Enable WPA in service profile *wpa-wep-for-mac*. Type the following command:

```
WX1200# set service-profile wpa-wep-for-mac wpa-ie enable
success: change accepted.
```

8 Enable the WEP40 cipher suite in service profile *wpa-wep-for-mac*. Type the following command:

```
WX1200# set service-profile wpa-wep-for-mac
cipher-wep40 enable
success: change accepted.
```

TKIP is already enabled by default when WPA is enabled.

9 Enable PSK authentication in service profile *wpa-wep-for-mac*. Type the following command:

```
WX1200# set service-profile wpa-wep-for-mac auth-psk enable
success: change accepted.
```

10 Configure a passphrase for the preshared key. Type the following command:

```
WX1200# set service-profile wpa-wep-for-mac psk-phrase
"passphrase to convert into a preshared key"
success: change accepted.
```

11 Display the WPA configuration changes. Type the following command:

```
WX1200# display service-profile sp1
ssid-name:                        voice       ssid-type:                crypto
Beacon:                             yes       Proxy ARP:                    no
DHCP restrict:                       no       No broadcast:                 no
Short retry limit:                    5       Long retry limit:              5
Auth fallthru:                     none       Sygate On-Demand (SODA):      no
Enforce SODA checks:                yes SODA remediation ACL:
Custom success web-page:                      Custom failure web-page:
Custom logout web-page:                       Custom agent-directory:
Static COS:                          no       COS:                           0
CAC mode:                          none       CAC sessions:                 14
User idle timeout:                  180       Idle client probing:         yes
Keep initial vlan:                   no       Web Portal Session Timeout:   5
Web Portal ACL:
WEP Key 1 value:                 <none>       WEP Key 2 value:          <none>
WEP Key 3 value:                 <none>       WEP Key 4 value:          <none>
WEP Unicast Index:                    1       WEP Multicast Index:           1
Shared Key Auth:                     NO
WPA enabled:
```

12 Map service profile *wpa-wep-for-mac* to radio profile *rp3*. Type the following commands:

```
WX1200# set radio-profile rp3 service-profile wpa-wep-for-mac
success: change accepted.
```

13 Apply radio profile *rp3* to radio 1 on port 4 and to radios 1 and 2 on port 6 and enable the radios, and verify the configuration changes. Type the following commands:

```
WX1200# set ap 4,6 radio 1 radio-profile rp3 mode enable
success: change accepted.
WX1200# set ap 6 radio 2 radio-profile rp3 mode enable
success: change accepted.
```

```
WX1200# display ap config
Port  4: AP model: MP-241, POE:  enable, bias: high, name: MAP04
           boot-download-enable: YES
           force-image-download: YES
  Radio 1: type: 802.11a, mode:  enabled, channel: 36
  tx pwr:  1, profile: rp3
  auto-tune max-power: default
Port  6: AP model: mp-252, POE:  enable, bias: high, name: MAP06
           boot-download-enable: YES
          force-image-download: YES
  Radio 1: type: 802.11g, mode:  enabled, channel: 6
  tx pwr:  1, profile: rp3
  auto-tune max-power: default
  Radio 2: type: 802.11a, mode: enabled, channel: 36
  tx pwr:  1, profile: rp3
  auto-tune max-power: default, min-client-rate: 24, max-retransmissions: 10
```

14 Save the configuration. Type the following command:

```
WX1200# save config
success: configuration saved.
```

14 CONFIGURING RF AUTO-TUNING

The RF Auto-Tuning feature dynamically assigns channel and power settings to MAP radios, and adjusts those settings when needed.

Overview

RF Auto-Tuning can perform the following tasks:

- Assign initial channel and power settings when a MAP radio is started.
- Periodically assess the RF environment and change the channel or power setting if needed.

By default, RF Auto-Tuning is enabled for channel configuration and disabled for power configuration.

Initial Channel and Power Assignment

The following process is used to assign the channel and power to a MAP radio when it is first enabled:

- If RF Auto-Tuning is *disabled* for both channel and power assignment, the radio uses the channel and power settings in the radio profile that manages the radio. After this, the channel and power do not change unless you change the settings in the radio profile, or enable RF Auto-Tuning.
- If RF Auto-Tuning is *enabled* for channel and power assignment, the radio performs an RF scan and reports the results to the WX switch that is managing the MAP the radio is on. The scan results include third-party access points. Based on the scan results, MSS sets the channel and power on the radio. MSS always selects channel and power settings that are valid for the country of operation.
  - **Initial channel assignment**—MSS selects a channel at random from the set of valid channels for the radio type and country code. After this, each subsequent time the radio or RF Auto-Tuning is restarted, a different channel is selected to ensure even distribution among the channels.

During radio operation, MSS periodically reevaluates the channel and changes it if needed. (See “Channel Tuning” on page 313.)

- **Initial power assignment**—The MAP sets a radio’s initial power level to the maximum value allowed for the country code (regulatory domain). In a deployment with few MAPs, the radio remains at maximum power. Otherwise, the radio reduces power until the power is just enough to reach the MAP’s nearest neighbor that is on the same channel.

How Channels Are Selected

When a radio first comes up, if RF Auto-Tuning for channels is enabled, the initial channel selected will follow a uniform distribution of channels that spans the list of channels, rather than selecting the next sequential channel number.

For example, the range of valid channels for 802.11a radios in the US is as follows:

36, 40, 44, 48, 149, 153, 157, 161

On each WX, the first channel chosen will be random. Assuming that channel 60 is the first channel selected, the order of the channel selections will be as follows:

Order:	2	5	8	3	6	1	4	7
Channel:	40	44	48	52	56	60	64	68

After these initial 8 channel selections are chosen, the pattern will repeat itself.

Channel and Power Tuning

RF Auto-Tuning can change the channel or power of a radio, to compensate for RF changes such as interference, or to maintain at least the minimum data transmit rate for associated clients. A radio continues to scan on its active data channel and on other channels and reports the results to its WX switch.

Periodically, the switch examines these results to determine whether the channel or the power needs to be changed.

Power Tuning

By default, the switch evaluates the scan results for possible power changes every 300 seconds (5 minutes), and raises or lowers the power level if needed.

If RF Auto-Tuning determines that a power change is needed on a radio, MSS ramps the power up or down until the new power level is reached. Ramp-up or ramp-down of the power occurs in 1 dBm increments, at regular time intervals. The default interval is 60 seconds and is configurable. The power ramp amount (1 dBm per interval) is not configurable.

Channel Tuning

By default, the switch evaluates the scan results for possible channel changes every 3600 seconds (1 hour). MSS uses the following parameters to determine whether to change the channel on a radio:

- Presence of active sessions.

  By default, If the radio has active sessions, MSS does not change the channel. If the radio does not have any active sessions, MSS uses the remaining parameters to determine whether to change the channel.
- Received signal strength indication (RSSI)
- Amount of noise on the channel
- Packet retransmission count, which is the rate at which the radio receives retransmitted packets.
- Utilization, calculated based on the number of multicast packets per second that a radio can send on a channel while continuously sending fixed-size frames over a period of time.
- Phy error count, which is the number of frames received by the MAP radio that have physical layer errors. A high number of Phy errors can indicate the presence of a non-802.11 device using the same RF spectrum.
- Received CRC error count. A high number of CRC errors can indicate a hidden node or co-channel interference.

The thresholds for these parameters are not configurable.
RF Auto-Tuning also can change a radio’s channel when the channel tuning interval expires, if a channel that has less disturbance is detected. *Disturbance* is based on the number of neighbors the radio has and each neighbor’s RSSI.

A radio also can change its channel before the channel tuning interval expires to respond to RF anomalies. An RF anomaly is a sudden major change in the RF environment, such as sudden major interference on the channel.

By default, a radio cannot change its channel more often than every 900 seconds, regardless of the RF environment. This channel holddown avoids unnecessary changes due to very transient RF changes, such as activation of a microwave oven.

Tuning the Transmit Data Rate

A radio sends beacons, probe requests, and probe responses at the minimum transmit data rate allowed for clients. This gives them the maximum distance. All other packets are transmitted at a rate determined by their destination. All packets are transmitted at the same power level.

By default, the following minimum data rates are allowed:

- 5.5 Mbps for 802.11b/g clients
- 24 Mbps for 802.11a clients

You can statically change the transmit data rates for radios, on a radio profile basis. (For information, see "Changing Transmit Rates" on page 235). However, RF Auto-Tuning does not change transmit rates automatically.

RF Auto-Tuning Parameters

Table 25 lists the RF Auto-Tuning parameters and their default settings.

Table 25 Defaults for RF Auto-Tuning Parameters

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
Radio profile parameters		
channel-config	**enable**	When the radio is first enabled, RF Auto-Tuning sets the channel based on the channels in use on neighboring access points.
channel-interval	**3600**	Every 3600 seconds, MSS examines the RF information gathered from the network and determines whether the channel needs to be changed to compensate for RF changes.

Table 25 Defaults for RF Auto-Tuning Parameters (continued)

Parameter	Default Value	Radio Behavior When Parameter Set to Default Value
channel-holddown	**900**	MSS maintains the channel setting on a radio for at least 900 seconds regardless of RF changes.
channel-lockdown	**disabled**	MSS continues to dynamically change channels if needed based on network conditions.
power-config	**disable**	MSS uses the highest power level allowed for the country of operation or the highest supported by the hardware, whichever is lower.
power-interval	**600**	Every 600 seconds, MSS examines the RF information gathered from the network and determines whether the power needs to be changed to compensate for RF changes.
power-lockdown	**disabled**	MSS continues to dynamically change power settings if needed based on network conditions.
power-ramp-interval	**60**	When RF Auto-Tuning determines that power should be increased or decreased, MSS changes the power by 1 dBm every 60 seconds until the power setting is reached..
Individual radio parameters		
max-power	Maximum allowed for country of operation	RF Auto-Tuning never sets a radio’s power to a level that is higher than the maximum allowed for the country of operation (countrycode).

Changing RF Auto-Tuning Settings

You can change the following RF Auto-Tuning settings:

- Channel tuning
- Power tuning
- Minimum transport data rate

Selecting Available Channels on the 802.11a Radio

You can configure the 802.11a radio on a MAP to allow certain channels to be available or unavailable. To enable this feature, use the following command:

```
set radio-profile name auto-tune 11a-channel-range
{lower-bands | all bands}
```

If you select `lower-bands`, MSS selects a channel from the lower eight bands in the 802.11a range of channels: 36, 40, 44, 48, 52, 56, 60, or 64.

If you select `all-bands`, MSS selects a channel from the entire 802.11a range of channels: 36, 40, 44, 48, 52, 60, 64, 149, 153, 157, or 161.

Changing Channel Tuning Settings

Disabling or Reenabling Channel Tuning

RF Auto-Tuning for channels is enabled by default. To disable or reenable the feature for all radios in a radio profile, use the following command:

```
set radio-profile name auto-tune channel-config
{enable | disable} [ignore-clients]
```

The **ignore-clients** option allows MSS to change the channel on a radio even if the radio has active client sessions. Without this option, MSS does not change the channel unless there are no active client sessions on the radio.

To disable channel tuning for radios in the *rp2* radio profile, type the following command:

```
WX1200# set radio-profile rp2 auto-tune channel-config
disable
success: change accepted.
```

Changing the Channel Tuning Interval

The default channel tuning interval is 3600 seconds. You can change the interval to a value from 0 to 65535 seconds. If you set the interval to 0, RF Auto-Tuning does not reevaluate the channel at regular intervals. However, RF Auto-Tuning can still change the channel in response to RF anomalies. 3Com recommends that you use an interval of at least 300 seconds (5 minutes).

To change the channel tuning interval, use the following command:

```
set radio-profile name auto-tune channel-interval seconds
```

To set the channel tuning interval for radios in radio profile *rp2* to 2700 seconds (45 minutes), type the following command:

```
WX1200# set radio-profile rp2 auto-tune channel-interval 2700
success: change accepted.
```

Changing the Channel Holddown Interval

The default channel holddown interval is 900 seconds. You can change the interval to a value from 0 to 65535 seconds. To change the channel holddown interval, use the following command:

```
set radio-profile name auto-tune channel-holddown holddown
```

To change the channel holddown for radios in radio profile *rp2* to 600 seconds, type the following command:

```
WX1200# set radio-profile rp2 auto-tune channel-holddown 600
success: change accepted.
```

Changing Power Tuning Settings

Enabling Power Tuning

RF Auto-Tuning for power is disabled by default. To enable or disable the feature for all radios in a radio profile, use the following command:

```
set radio-profile name auto-tune
power-config {enable | disable}
```

To enable power tuning for radios in the *rp2* radio profile, type the following command:

```
WX1200# set radio-profile rp2 auto-tune power-config enable
success: change accepted.
```

Changing the Power Tuning Interval

The default power tuning interval is 600 seconds. You can change the interval to a value from 1 to 65535 seconds. To change the power tuning interval, use the following command:

```
set radio-profile name auto-tune power-interval seconds
```

To set the power tuning interval for radios in radio profile *rp2* to 240 seconds, type the following command:

```
WX1200# set radio-profile rp2 auto-tune power-interval 240
success: change accepted.
```

Changing the Maximum Default Power Allowed On a Radio

By default, the maximum power level that RF Auto-Tuning can set on a radio is the same as the maximum power level allowed for the country of operation. To change the maximum power level that RF Auto-Tuning can assign, use the following command:

```
set ap apnumber radio {1 | 2} auto-tune max-power power-level
```

The *power-level* can be a value from 1 to 20.

To set the maximum power that RF Auto-Tuning can set on radio 1 on the MAP on port 6 to 12 dBm, type the following command.

```
WX1200# set ap 6 radio 1 auto-tune max-power 12
success: change accepted.
```

Locking Down Tuned Settings

You can convert dynamically assigned channels and power settings into statically configured settings, by locking them down. When you lock down channel or power settings, MSS converts the latest values set by RF Auto-Tuning into static settings.

You can lock down channel or power settings on a radio-profile basis. MSS implements the lock down by changing the **set** {**ap** | **dap**} **radio channel** or **set** {**ap** | **dap**} **radio tx-power** command for each radio managed by the radio profile.

To lock down channel or power settings, use the following commands:

```
set radio-profile name auto-tune channel-lockdown
set radio-profile name auto-tune power-lockdown
```

To verify the static settings, use the **`display`** `{`**`ap`** `|` **`dap`**`}` **`config`** command.

To save the locked down settings, you must save the switch's configuration.

The following commands lock down the channel and power settings for radios in radio profile rp2:

```
WX1200# set radio-profile rp2 auto-tune channel-lockdown
success: change accepted.
WX1200# set radio-profile rp2 auto-tune power-lockdown
success: change accepted.
```

Displaying RF Auto-Tuning Information

You can display the RF Auto-Tuning configuration, a list of RF neighbors, and the values of RF attributes.

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying RF Auto-Tuning Settings

To display the RF Auto-Tuning settings that you can configure in a radio profile, use the following command:

`display radio-profile` `{`*`name`* `|` **`?`**`}`

Entering **display radio-profile ?** displays a list of radio profiles.

To display the RF Auto-Tuning and other settings in the *default* radio profile, type the following command:

```
WX# display radio-profile default
Beacon Interval:                 100   DTIM Interval:                   1
Max Tx Lifetime:                2000   Max Rx Lifetime:              2000
RTS Threshold:                  2346   Frag Threshold:               2346
Long Preamble:                    no   Tune Channel:                  yes
Tune Channel Range (11a):  lower-bands Ignore Clients:                 no
Tune Power:                       no   Tune Channel Interval:        3600
Tune Power Interval:             600   Power ramp interval:            60
Channel Holddown:                300   Countermeasures:              none
Active-Scan:                     yes   RFID enabled:                   no
WMM Powersave:                    no   QoS Mode:                      wmm
Rate Enforcement:                 no   Initial Load:                 1000
ETT Link Factor:                   3   Change Threshold:               25
Dwell Time:                     3600   Probe Interval:                 60
Intial Measur Interval:           60   Maximum Measure Interval:      600
Radio Link Timeout:                5
```

To display the RF Auto-Tuning settings that you can configure on an individual radio, use the following commands:

```
display ap config [port-list [radio {1 | 2}]]
display ap config [ap-num [radio {1 | 2}]]
```

To display the RF Auto-Tuning and other individual radio settings on radio 1 of a directly connected MAP connected to WX port 2, type the following command:

```
WX# display ap config 2 radio 1
Port 2: AP model: mp-352, POE: enabled, bias: high, name:
MAP02
boot-downloaded-enable: YES
force-image-download:    NO
Radio 1: type: 802.11g, mode: disabled, channel: 5
tx pwr: 1, profile: default
auto-tune max-power: default
```

To display the RF Auto-Tuning and other individual radio settings on both radios on the MAP access point configured on connection 1, type the following command:

```
WX# display ap config 1
Dap 1: serial-id: 12345678, AP model: mp-352, bias: high, name: DAP01
       fingerprint: b4:f9:2a:52:37:58:f4:d0:10:75:43:2f:45:c9:52:c3
       boot-download-enable: YES
       force-image-download: NO
Radio 1: type: 802.11g, mode: disabled, channel: 6
tx pwr: 1, profile: default
auto-tune max-power: default
Radio 2: type: 802.11a, mode: disabled, channel: 36
tx pwr: 1, profile: default
auto-tune max-power: default
```

Displaying RF Neighbors

To display the other radios that a specific 3Com radio can hear, use the following commands:

```
display auto-tune neighbors [ap map-num [radio {1 | 2| all}]]

display auto-tune neighbors
[ap ap-num [radio {1 | 2 | all}]
```

The list of radios includes beaconed third-party SSIDs, and both beaconed and unbeaconed 3Com SSIDs.

To display neighbor information for radio 1 on the directly connected MAP on port 2, type the following command:

```
WX1200# display auto-tune neighbors ap 2 radio 1
Total number of entries for port 2 radio 1: 5
Channel Neighbor BSS/MAC  RSSI
------- ----------------- ----
      1 00:0b:85:06:e3:60  -46
      1 00:0b:0e:00:0a:80  -78
      1 00:0b:0e:00:d2:c0  -74
      1 00:0b:85:06:dd:00  -50
      1 00:0b:0e:00:05:c1  -72
```

Displaying RF Attributes

To display the current values of the RF attributes RF Auto-Tuning uses to decide whether to change channel or power settings, use the following commands:

```
display auto-tune attributes
[ap map-num [radio {1 | 2| all}]]
display auto-tune attributes
[ap ap-num [radio {1 | 2| all}]]
```

To display RF attribute information for radio 1 on the directly connected MAP on port 2, type the following command:

```
WX1200# display auto-tune attributes ap 2 radio 1
Auto-tune attributes for port 2 radio 1:
 Noise:                   -92 Packet Retransmission
Count:          0
 Utilization:               0 Phy Errors
Count:                     0
 CRC Errors count:      122
```

15

CONFIGURING MAPS TO BE AEROSCOUT LISTENERS

AeroScout RFID tags are wireless transmitters that you can place on assets such as office equipment to track the equipment's location. Each tag regularly transmits its unique ID. AeroScout listeners detect the transmissions from the RFID tags and relay this information to an AeroScout Engine or a WX. You can use an AeroScout Engine or 3Com Wireless Switch Manager to locate the asset.

MAPs can be configured as AeroScout listeners. A MAP configured to be an AeroScout listener detects RFID tag IDs and sends the tag information to the WX switch managing the MAP. If an AeroScout Engine is configured to request the information from the MAP, the MAP also sends the information to the AeroScout Engine.

The accuracy of the location information depends on the number of listeners (MAPs). 3Com recommends that you configure at least three listeners.

You can configure Distributed MAPs or directly connected MAPs to listen for RFID tags. However, if you plan to use an AeroScout Engine to display asset locations, you must use Distributed MAPs. RFID tag information from directly connected MAPs is available only to 3Com Wireless Switch Manager.

Configuring MAP Radios to Listen for AeroScout RFID Tags

To configure MAP radios to listen for AeroScout RFID tags:

- Configure a service profile for the AeroScout listeners and set the SSID type to clear (unencrypted).
- Configure a radio profile for the AeroScout listeners.
- Disable RF Auto-Tuning of channels on the radio profile. Channels on RFID tags are statically configured. Therefore, the listener should not dynamically change channels.
- Disable active scan on the radio profile. When active scan is enabled, radios go off-channel for brief intervals to scan for rogues.
- Enable RFID mode on the radio profile. RFID mode allows MAP radios to accept Aeroscout Engine commands. A MAP will forward RFID tags to an Aeroscout Engine after receiving an Enable Access Point command from the Aeroscout Engine.
- Map the AeroScout listeners' service profile to the radio profile.
- Set the channel on each radio to the channel on which the RFID tags transmit. You can use the same channel on all the RFID tags.
- Map the MAP radios to the radio profile and enable the radios.

A MAP always forwards RFID tag information to its WX switch, even if RFID mode is disabled.

The following example shows the commands to configure three MAPs to be AeroScout listeners. This example assumes that the MAPs have already been installed and configured.

```
WX1200# set service-profile rfid-listeners ssid-type clear
success: change accepted.
WX1200# set radio-profile rfid-listeners active-scan disable
success: change accepted.
WX1200# set radio-profile rfid-listeners auto-tune channel-config disable
success: change accepted.
WX1200# set radio-profile rfid-listeners rfid-mode enable
success: change accepted.
WX1200# set radio-profile rfid-listeners service-profile rfid-listeners
success: change accepted.
WX1200# set ap 67 radio 1 channel 7
success: change accepted.
WX1200# set ap 68 radio 1 channel 7
success: change accepted.
```

```
WX1200# set ap 69 radio 1 channel 7
success: change accepted.
WX1200# set ap 67 radio 1 radio-profile rfid-listeners mode enable
success: change accepted.
WX1200# set ap 68 radio 1 radio-profile rfid-listeners mode enable
success: change accepted.
WX1200# set ap 69 radio 1 radio-profile rfid-listeners mode enable
success: change accepted.
```

Locating an RFID Tag

You can use an AeroScout Engine or 3Com Wireless Switch Manager to locate an asset to which an RFID tag is attached.

Using an AeroScout Engine

1. Load the site map in AeroScout System Manager.
2. Mark the origin point (0,0), if not already done.
3. Calibrate distance, if not already done.
4. Add each MAP configured as a listener to the map, and enter its IP address.

   *To look up a Distributed MAP IP address, use the **display ap status** command.*
5. Enable RSSI location calculation.
6. Enable tag positioning.
7. Enable the map to use the MAPs.

   To check the status of a MAP, right-click on the MAP icon and select **Status**.

Using 3Com Wireless Switch Manager

If your network is modeled in a 3Com Wireless Switch Manager network plan, you can use 3Com Wireless Switch Manager to locate devices that have AeroScout asset tags. This capability requires the following:

- Three or more listeners are required for optimal location results. 3Com Wireless Switch Manager will attempt to display a tag's location even if there are fewer than three listeners, but the location might not be accurate.
- The listener MAPs must be in the network plan, on the floor where the asset tags are located.

1. Connect to 3Com Wireless Switch Manager Services (the server) and open the network plan that contains the site information.
2. Select the Monitor tool bar option (at the top of the main 3Com Wireless Switch Manager window). The Monitor dashboard appears.
3. Under the Clients graph, click **Details**.
4. In the Manage menu of the Task List panel, select **Find AeroScout Tag**. The Find AeroScout Tags dialog appears.
5. Enter the search criteria:
   - a Select **Find all AeroScout Tags**, or leave Find a specific AeroScout Tag selected and type the MAC address of the asset tag.
   - b Select the search scope.
6. Click **Next**. A list of asset tags appears.
7. To locate an asset:
   - a Select its tag in the list.
   - b Select **Locate AeroScout Tag**.

   A picture of the floor plan where the tag is located appears. The likely location of the asset is indicated.

16 CONFIGURING QUALITY OF SERVICE

This chapter describes the Quality of Service (QoS) features supported in MSS and how to configure and manage them.

About QoS

MSS supports Layer 2 and Layer 3 classification and marking of traffic, and optimized forwarding of wireless traffic for time-sensitive applications such as voice and video.

Summary of QoS Features

QoS features are configured in radio profiles and service profiles. Table 26 lists the QoS features in MSS.

Table 26 QoS Parameters

QoS Feature	Description	Configuration Command
QoS parameters configured in the radio profile		
QoS mode	Method used to classify and mark traffic, and to select forwarding queues on MAPs. One of the following modes can be enabled: SpectraLink Voice Priority Voice-Extension, for NEC handsets (the default) Wi-Fi Multimedia	**set radio-profile qos-mode** See the following: ▪ "QoS Mode" on page 330 ▪ "Changing the QoS Mode" on page 342
WMM powersave support	Unscheduled Automatic Powersave Delivery (U-APSD). U-APSD enables clients that use powersave mode to more efficiently request buffered unicast packets from MAP radios.	**set radio-profile wmm-powersave**

Table 26 QoS Parameters (continued)

QoS Feature	Description	Configuration Command
QoS parameters configured in service profiles		
CAC mode	Call Admission Control, which regulates addition of new VoIP sessions on MAP radios. One of the following modes can be enabled: - None (the default) - Session-based	**set service-profile cac-mode** See the following: - "Call Admission Control" on page 340 - "Configuring Call Admission Control" on page 343
Static CoS	Simple CoS assignment. When enabled, static CoS assigns the same CoS value to all traffic on the service profile's SSID. Static CoS is disabled by default. The default static CoS value is 0.	**set service-profile static-cos** set service-profile cos See the following: - "Static CoS" on page 341 - "Configuring Static CoS" on page 343
Using client DSCP value	Whether MSS classifies the QoS level of IP packets based on their DSCP value, instead of their 802.11 priority.	**set service-profile use-client-dscp** See "Using the Client's DSCP Value to Classify QoS Level" on page 344.

Table 26 QoS Parameters (continued)

QoS Feature	Description	Configuration Command
Transmit rates	Data transmission rates supported by each radio type. The following categories are specified: ■ Beacon ■ Multicast ■ Mandatory (a client must support at least one of these rates to associate) ■ Disabled ■ Standard (valid rates that are not disabled and are not mandatory) Defaults: ■ Mandatory: - 802.11a—6.0, 12.0, 24.0 - 802.11b—5.5, 11.0 - 802.11g—1.0, 2.0, 5.5, 11.0 ■ Disabled—None. All rates applicable to the radio type are supported by default. ■ Beacon: - 802.11a—6.0 - 802.11b—5.5 - 802.11g—5.5 ■ Multicast—auto for all radio types (highest rate that can reach all associated clients is used)	**set service-profile transmit-rates** See “Changing Transmit Rates” on page 235.

Table 26 QoS Parameters (continued)

QoS Feature	Description	Configuration Command
Broadcast control	Mechanisms to reduce overhead caused by wireless broadcast traffic or traffic from unauthenticated clients. One or more of the following can be enabled: ■ Proxy ARP ■ No-Broadcast ■ DHCP Restrict All three options are disabled by default.	**set service-profile proxy-arp** **set service-profile no-broadcast** **set service-profile dhcp-restrict** See the following: ■ "Broadcast Control" on page 341 ■ "Enabling Broadcast Control" on page 345
Session timers	Keepalives and timeouts for clients sessions. The following timeout parameters can be configured: ■ user idle timeout—Period a client can remain idle before being disassociated (default: 180 seconds) ■ idle-client probing—keepalives sent to clients (enabled by default)	**set service-profile user-idle-timeout** **set service-profile idle-client-probing** See "Displaying and Changing Network Session Timers" on page 565.

QoS Mode

MSS supports Layer 2 and Layer 3 classification and marking of traffic, to help provide end-to-end QoS throughout the network. The following modes of QoS are supported:

- Wi-Fi Multimedia (WMM)—Provides wireless QoS for time-sensitive applications such as voice and video. WMM QoS is enabled by default and does not require any configuration.
- SpectraLink Voice Priority (SVP)—Provides optimized forwarding of SVP voice traffic. SVP QoS is disabled by default.

Session-based Call Admission Control (CAC) is also supported. You can use CAC with either QoS mode to ensure bandwidth availability by limiting the number of active sessions a radio can have.

The static CoS option enables you to easily set CoS for all traffic on an SSID by marking all the SSID's traffic with the same CoS value.

You can use ACLs to override CoS markings or set CoS for non-WMM traffic.

The following sections describe each of these options.

WMM QoS Mode

WX switches and MAPs each provide classification and marking for WMM QoS:

- WX switches classify and mark traffic based on 802.1p tag value (for tagged traffic) or Differentiated Services Code Point (DSCP) value.
- MAPs classify ingress traffic from wireless clients based on the service type value in the 802.11 header, and mark the DSCP value in the IP tunnel on which the MAP forwards the user traffic to the WX.

  MAPs place traffic from a WX to a wireless client in a forwarding queue based on the DSCP value in the tunnel carrying the traffic, then forward the traffic based on the queue's priority.

Figure 24 on page 332 shows how WX switches classify ingress traffic.

Figure 25 on page 333 shows how WX switches mark egress traffic.

Figure 26 on page 334 and Figure 27 on page 335 show how MAPs classify ingress traffic and mark egress traffic.

The figures show the default mappings between DSCP and CoS. (For information about changing CoS mappings, see "Changing CoS Mappings" on page 344.)

Figure 24 QoS on WX Switches—Classification of Ingress Packets

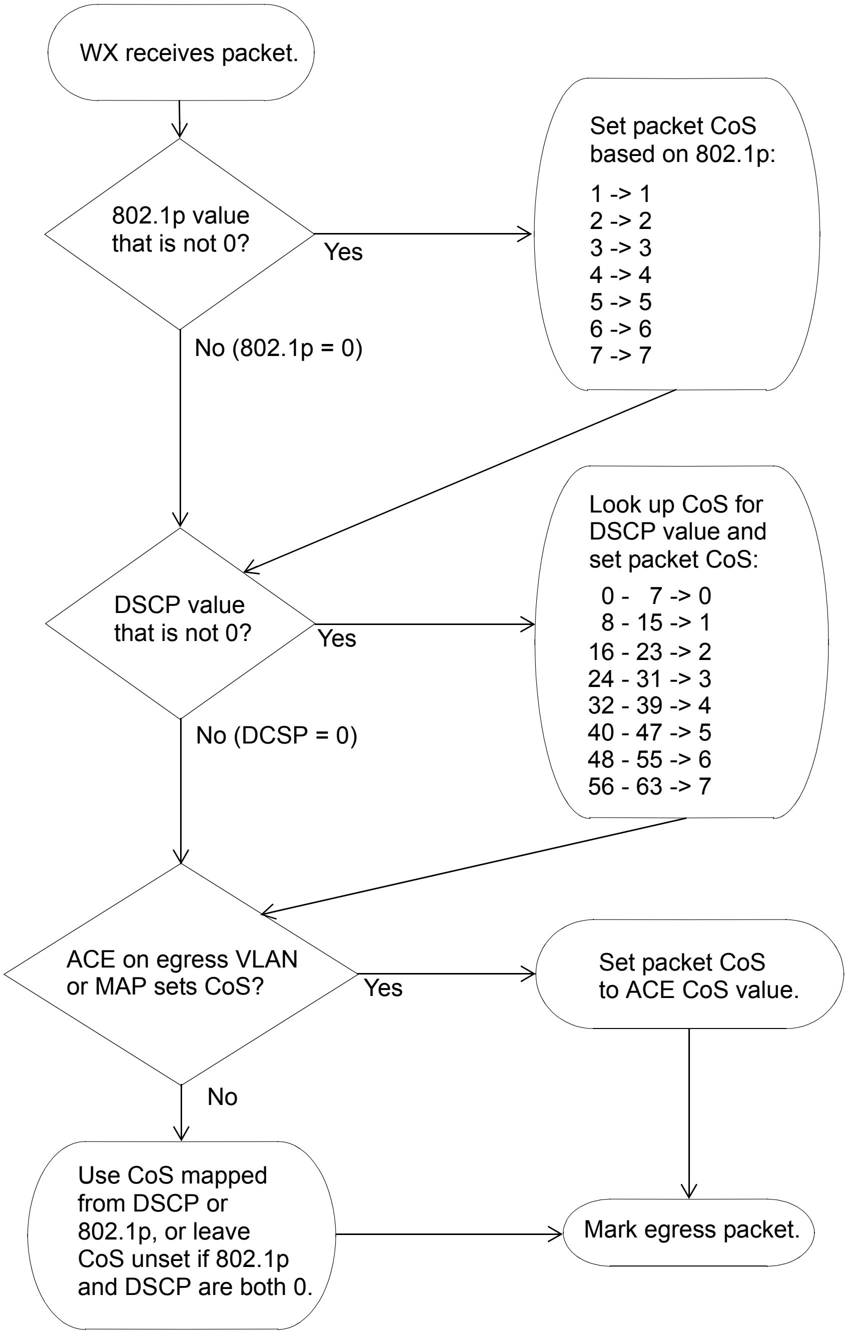

WX receives packet.
802.1p value that is not 0?
Yes
Set packet CoS based on 802.1p:
1 -> 1
2 -> 2
3 -> 3
4 -> 4
5 -> 5
6 -> 6
7 -> 7
No (802.1p = 0)
DSCP value that is not 0?
Yes
Look up CoS for DSCP value and set packet CoS:
0 - 7 -> 0
8 - 15 -> 1
16 - 23 -> 2
24 - 31 -> 3
32 - 39 -> 4
40 - 47 -> 5
48 - 55 -> 6
56 - 63 -> 7
No (DCSP = 0)
ACE on egress VLAN or MAP sets CoS?
Yes
Set packet CoS to ACE CoS value.
No
Use CoS mapped from DSCP or 802.1p, or leave CoS unset if 802.1p and DSCP are both 0.
Mark egress packet.

Figure 25 QoS on WX Switches—Marking of Egress Packets

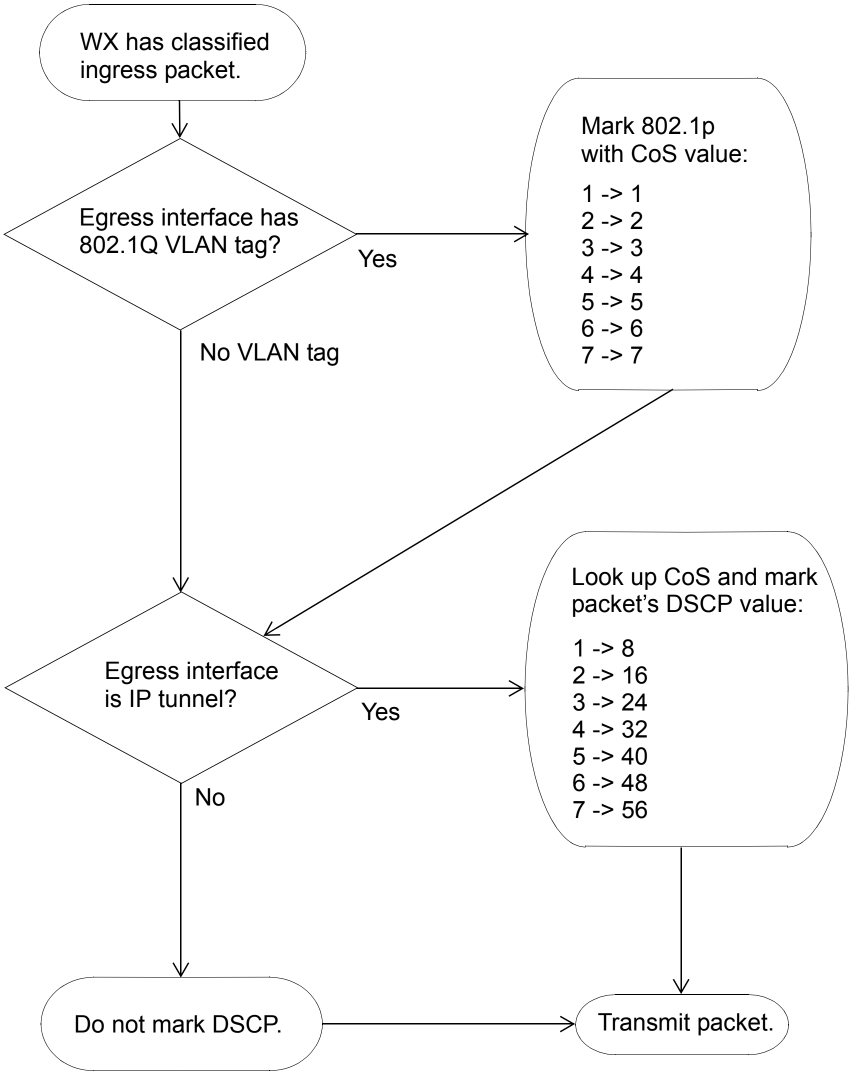

WX has classified ingress packet.
Egress interface has 802.1Q VLAN tag?
Yes
Mark 802.1p with CoS value:
1 -> 1
2 -> 2
3 -> 3
4 -> 4
5 -> 5
6 -> 6
7 -> 7
No VLAN tag
Look up CoS and mark packet's DSCP value:
1 -> 8
2 -> 16
3 -> 24
4 -> 32
5 -> 40
6 -> 48
7 -> 56
Egress interface is IP tunnel?
Yes
No
Do not mark DSCP.
Transmit packet.

Figure 26 QoS on MAPs—Classification and Marking of Packets from Clients to WX

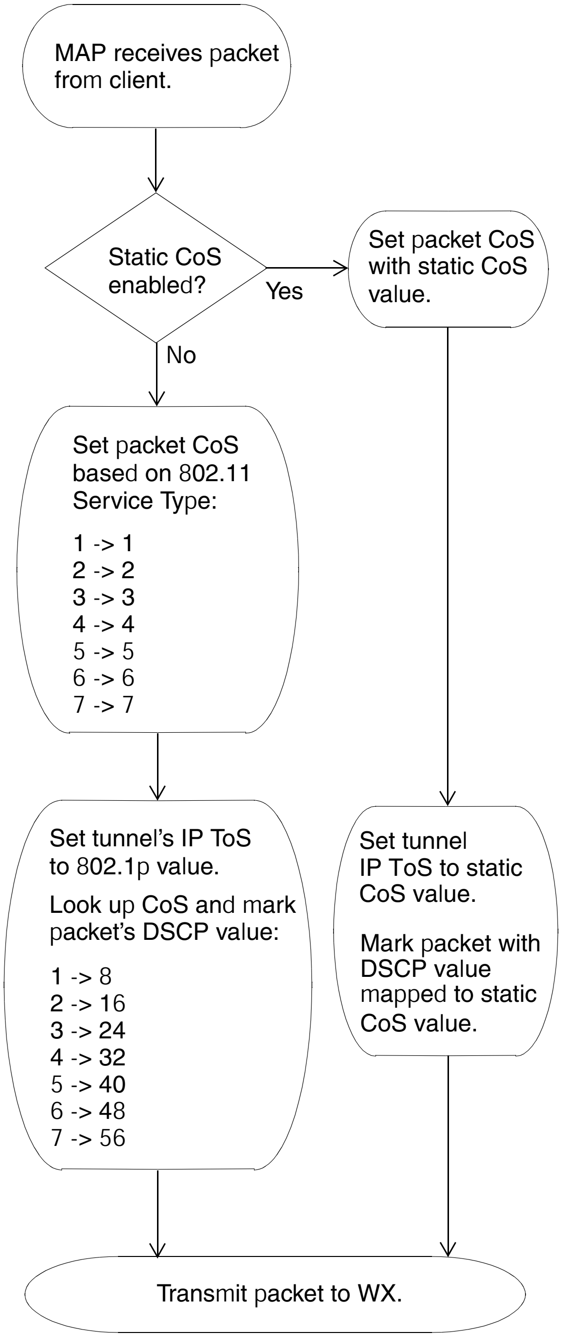
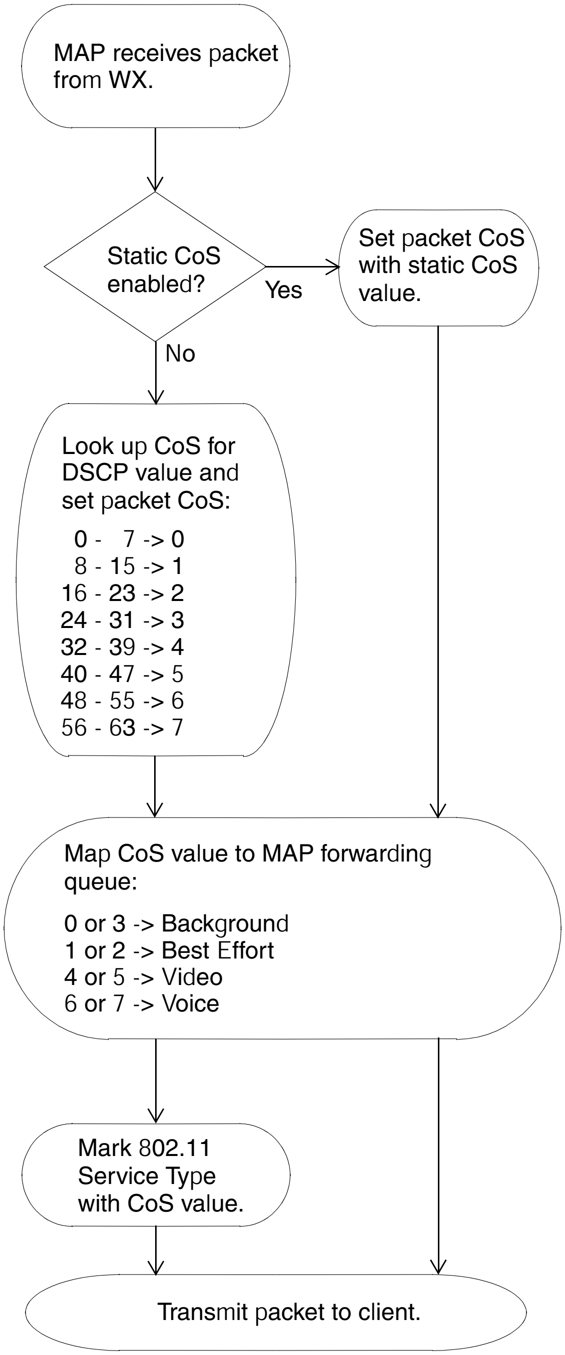

MAP receives packet from client.
Static CoS enabled?
Yes
Set packet CoS with static CoS value.
No
Set packet CoS based on 802.11 Service Type:
1 -> 1
2 -> 2
3 -> 3
4 -> 4
5 -> 5
6 -> 6
7 -> 7
Set tunnel's IP ToS to 802.1p value.
Look up CoS and mark packet's DSCP value:
1 -> 8
2 -> 16
3 -> 24
4 -> 32
5 -> 40
6 -> 48
7 -> 56
Set tunnel IP ToS to static CoS value.
Mark packet with DSCP value mapped to static CoS value.
Transmit packet to WX.

Figure 27 QoS on MAPs—Classification and Marking of Packets from WX to Clients


MAP receives packet from WX.
Static CoS enabled?
Yes
Set packet CoS with static CoS value.
No
Look up CoS for DSCP value and set packet CoS:
0 - 7 -> 0
8 - 15 -> 1
16 - 23 -> 2
24 - 31 -> 3
32 - 39 -> 4
40 - 47 -> 5
48 - 55 -> 6
56 - 63 -> 7
Map CoS value to MAP forwarding queue:
0 or 3 -> Background
1 or 2 -> Best Effort
4 or 5 -> Video
6 or 7 -> Voice
Mark 802.11 Service Type with CoS value.
Transmit packet to client.

The following sections describe in more detail how the WMM QoS mode works on WX switches and MAPs.

WMM QoS on the WX Switch

MSS performs classification on ingress to determine a packet’s CoS value. This CoS value is used to mark the packet at the egress interface.

The classification and marking performed by the switch depend on whether the ingress interface has an 802.1p or DSCP value other than 0, and whether the egress interface is tagged or is an IP tunnel.

The mappings between DSCP and CoS values are configurable. (See “Changing CoS Mappings” on page 344.) 802.1p and CoS values map directly and are not configurable. DSCP 0 of the DSCP-to-CoS map is reserved. 802.1p determines CoS for packets with DSCP 0. CoS 0 of the CoS-to-DSCP map is also reserved. CoS 0 packets are marked with DSCP 0.

Table 27 shows how WMM priority information is mapped across the network. When WMM is enabled, 3Com switches and MAPs perform these mappings automatically.

Table 27 WMM Priority Mappings

Service Type	IP Precedence	IP ToS	DSCP	802.1p	CoS	MAP Forwarding Queue
0	0	0	0	0	0	Background
3	3	0x60	24	3	3	
1	1	0x20	8	1	1	Best Effort
2	2	0x40	16	2	2	
4	4	0x80	32	4	4	Video
5	5	0xa0	40	5	5	
6	6	0xc0	48	6	6	Voice
7	7	0xe0	56	7	7	

You can use static CoS to assign the same CoS value to all packets for a specific SSID. The static CoS value is assigned on the MAP, in both traffic directions (from the client to the WX and from the WX to the client). (For information, see “Configuring Static CoS” on page 343.)

You also can use ACLs to override marking for specific packets. Configure ACEs that use the **dscp** option to match on ingress DSCP value, and use the **cos** option to mark CoS. A CoS value assigned by an ACE overrides the internal CoS value. (For information, see "Using ACLs to Change CoS" on page 399.)

WMM QoS on a MAP

MAPs use forwarding queues to prioritize traffic for wireless clients.

For a packet received by the MAP from a client, the MAP classifies the packet based on the service type in the 802.11 header and maps the service type value to an internal CoS value. The MAP then marks the DSCP value in the IP tunnel header to the WX switch based on the internal CoS value.

For a packet received from a WX switch and addressed to a client, the MAP classifies the packet by mapping the DSCP value in the IP tunnel header to an internal CoS value. The MAP then assigns the packet to a forwarding queue based on the internal CoS value. The MAP also marks the service type in the 802.11 header based on the internal CoS value.

A MAP uses the DSCP-to-CoS and CoS-to-DSCP mappings of the WX switch that is managing it. If you change mappings on a WX switch, the change also applies to the MAP. Likewise, if a MAP changes to another WX switch (for example, after a MAP restart), the MAP uses the mappings in effect on the new WX.

If the **use-client-dscp** option is enabled for a service profile, WMM QoS is ignored, and the QoS level is classified based on the DSCP value. 802.11 data packets without WMM are classified as QoS level 0 unless static CoS is enabled or the **use-client-dscp** option is enabled.

Table 28 lists the default mappings between a MAP's internal CoS values and its forwarding queues.

Table 28 Default CoS-to-MAP-Forwarding-Queue Mappings

CoS	MAP Forwarding Queue
1 or 2	Background
0 or 3	Best Effort
4 or 5	Video
6 or 7	Voice

(To display a MAP’s CoS mappings and queue usage statistics, see “Displaying MAP Forwarding Queue Statistics” on page 349.)

Figure 28 shows an example of end-to-end QoS in a 3Com network. In this example, voice traffic is prioritized based on WMM. This example assumes that the QoS mappings are set to their default values.

Figure 28 WMM QoS in a 3Com Network

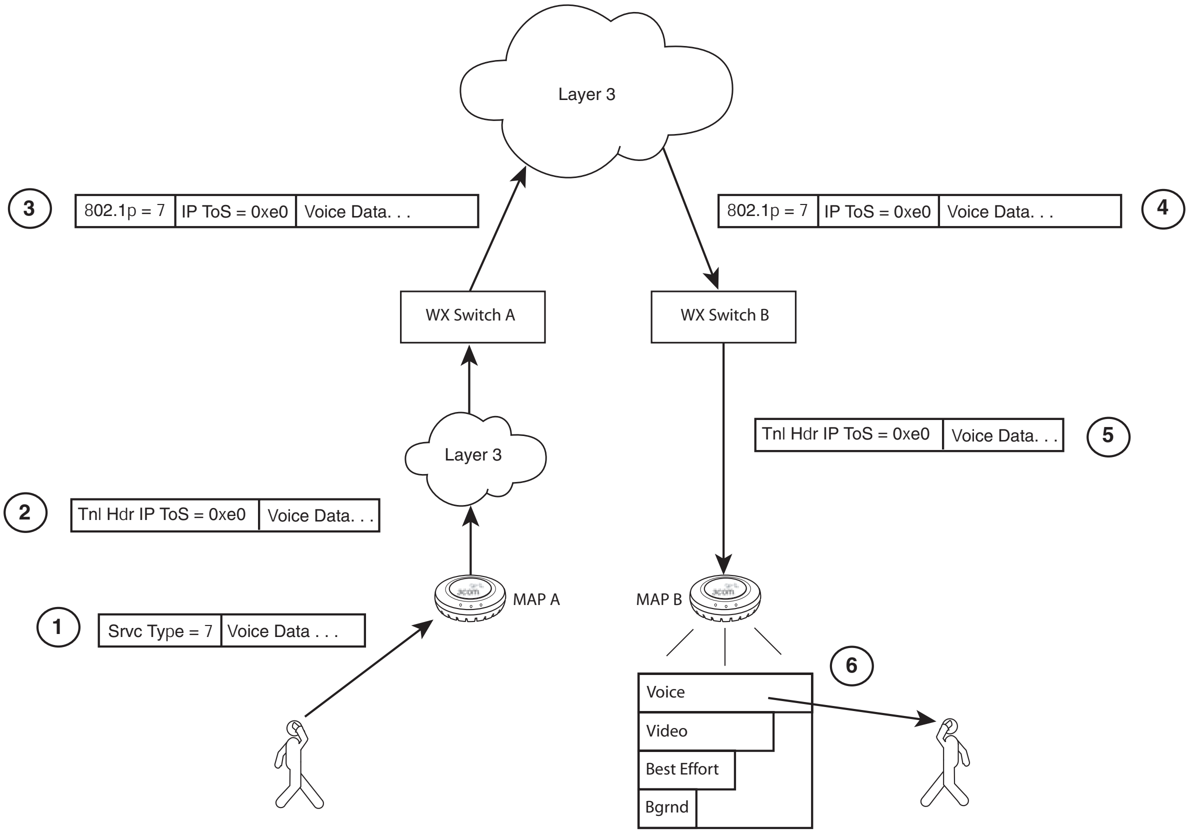

Layer 3
3
802.1p = 7
IP ToS = 0xe0
Voice Data. . .
802.1p = 7
IP ToS = 0xe0
Voice Data. . .
4
WX Switch A
WX Switch B
Tnl Hdr IP ToS = 0xe0
Voice Data. . .
5
Layer 3
2
Tnl Hdr IP ToS = 0xe0
Voice Data. . .
MAP A
MAP B
1
Srvc Type = 7
Voice Data . . .
6
Voice
Video
Best Effort
Bgrnd

Figure 28 shows the following process:

1. A user sends voice traffic from a WMM VoIP phone. The phone marks the CoS field of the packet with service type 7, indicating that the packet is for high priority (voice) traffic.
2. MAP A receives the voice packet and classifies the packet by mapping the service type in the 802.11 header to an internal CoS value. In this example, the service type is 7 and maps to internal CoS 7.

The MAP encapsulates the data in an IP tunnel packet, and marks the DSCP value in the tunnel header based on the internal CoS value. In this example, the MAP maps internal CoS 7 to DSCP 56 and marks the IP tunnel header's DSCP field with value 56. The MAP then sends the packet to the WX switch.

3 WX A receives the packet on the IP tunnel connecting the WX to MAP A. The WX classifies the packet based on the DSCP value in the IP header of the tunnel packet (in this example, DSCP 56), and maps this value to an internal CoS value (in this example, 7).

In this example, the WX interface with the MAP is untagged, so the WX does not classify the packet based on its 802.1p value.

WX A marks the packet based on the packet's internal CoS value. In this example, the egress interface is in a VLAN and has an 802.1Q VLAN tag. Therefore, the WX marks both the 802.1p value (with 7) and the tunnel header's DSCP value (with 56). WX A sends the packet to WX B on the IP tunnel that connects the two switches.

In An ACL can override a packet's marking. If a packet matches a permit ACL mapped to the outbound traffic direction on the MAP port, Distributed MAP, or user VLAN, and the ACL sets the CoS value, the tunnel header's DSCP value is marked based on the CoS value in the ACL instead.

4 WX B receives the packet from the Layer 3 cloud. The packet has an 802.1Q VLAN tag, so the WX classifies the packet by mapping its 802.1p value (in this example, 7) to the matching internal CoS value (also 7). However, because the packet also has a non-zero value in the DSCP field of the tunnel header, the WX reclassifies the packet by mapping the DSCP value (56) to an internal CoS value (7) instead.

5 WX B encapsulates the packet in an IP tunnel packet and marks the DSCP value in the tunnel header based on the packet's internal CoS value. In this example, the WX marks the tunnel header with DSCP 56. WX B sends the packet to MAP B on the IP tunnel that connects them.

6 MAP B receives the packet and does the following:

- Maps the DSCP value in the tunnel header (56) to an internal CoS value (7).
- Marks the packet's service type based on the internal CoS value (7).
- Places the packet in a forwarding queue (Voice) based on the internal CoS value (7).

In this example, the MAP places the packet in the Voice forwarding queue. The Voice queue has statistically more access to the air than the other queues, so the user's voice traffic receives priority treatment.

SVP QoS Mode

The SVP QoS mode optimizes forwarding of SVP traffic by setting the random wait time a MAP radio waits before transmitting the traffic to 0 microseconds.

Normally, a MAP radio waits an additional number of microseconds following the fixed wait time, before forwarding a queued packet or frame. Each forwarding queue has a different range of possible random wait times. The Voice queue has the narrowest range, whereas the Background and Best Effort queues have the widest range. The random wait times ensure that the Voice queue gets statistically more access to the air than the other queues.

By setting the random wait time to 0 for SVP, the SVP QoS mode provides SVP traffic the greatest possible access to the air, on a statistical basis. The QoS mode affects forwarding of SVP traffic only. The random wait times for other types of traffic are the same as those used when the QoS mode is WMM.

Call Admission Control

Call Admission Control (CAC) is an optional feature that helps ensure that high-priority clients have adequate bandwidth, by limiting the number of active sessions MAP radios can have for an SSID. For example, you can limit the number of active sessions on a VoIP SSID to ensure that each call receives the bandwidth required for quality voice service.

You can use CAC with either QoS mode (WMM or SVP).

CAC is disabled by default. You can enable session-based CAC on a service-profile basis. When enabled, CAC limits the number of active sessions a radio can have to 14 by default. You can change the maximum number of sessions to a value from 0 to 100.

CAC is configured on a service profile basis and limits association to radios only for the service profile's SSID. Association to the radios by clients on other SSIDs is not limited. To ensure voice quality, do not map other service profiles to the radio profile you plan to use for voice traffic.

(To configure CAC, see "Configuring Call Admission Control" on page 343.)

Broadcast Control

You also can enhance bandwidth availability on an SSID by enabling the following broadcast control features:

- Proxy ARP—WX responds on behalf of wireless clients to ARP requests for their IP addresses.
- DHCP Restrict—WX captures and does not forward any traffic except DHCP traffic for a wireless client who is still being authenticated and authorized.
- No Broadcast—Sends unicasts to clients for ARP requests and DHCP Offers and Acks instead of forwarding them as multicasts.

All these broadcast control options are disabled by default.

(To enable broadcast control features, see "Enabling Broadcast Control" on page 345.)

Static CoS

You can configure MSS to mark all wireless traffic on an SSID with a specific CoS value. When static CoS is enabled, the MAP marks all traffic between clients and the WX for a given SSID with the static CoS value. The static CoS value must be configured on the SSID's service profile.

Static CoS is the simplest method of CoS marking to configure. However, the static CoS value applies to all traffic regardless of traffic type. To instead assign CoS based on specific traffic types within an SSID, use an ACL. (See "Overriding CoS".)

When static CoS is enabled, you cannot override the static CoS value by using ACLs to mark CoS.

Overriding CoS

You can configure an ACL that marks packets that match the ACL with a specific CoS value. CoS is not changed in packets that do not match the ACE (ACL rule) that sets the CoS. (For more information, see "Enabling Prioritization for Legacy Voice over IP" on page 401.)

If static CoS is enabled, the static CoS value is always used. The CoS cannot be changed using an ACL.

Changing QoS Settings

You can change the settings of the following QoS options:

- QoS mode
- U-APSD support
- CAC state and maximum number of sessions
- Broadcast control
- Static CoS state and CoS value
- DSCP-CoS mappings
- Using client DSCP value to classify QoS level of IP packets

The QoS mode is configurable on a radio-profile basis. CAC and static CoS are configurable on a service-profile basis. DSCP-CoS mapping is configurable on a global switch basis.

Changing the QoS Mode

The default QoS mode is WMM. To change the QoS mode on a radio profile, use the following command:

```
set radio-profile name qos-mode {svp | wmm}
```

For example, the following command changes the QoS mode for radio profile *rp1* to SVP:

```
WX1200# set radio-profile rp1 qos-mode svp
success: change accepted.
```

SVP configuration requires ACLs to set CoS, in addition to the SVP QoS mode. (For information, see "Enabling SVP Optimization for SpectraLink Phones" on page 404.)

Enabling U-APSD Support

U-APSD support is disabled by default. To enable it on a radio profile, use the following command:

```
set radio-profile name wmm-powersave {enable | disable}
```

For example, the following command enables U-APSD on radio profile *rp1*:

```
WX# set radio-profile rp1 wmm-powersave enable
success: change accepted.
```

Configuring Call Admission Control

To configure CAC for an SSID, enable the feature on the SSID's service profile. When enabled, CAC limits the number of active sessions a radio can have to 14 by default. You can change the maximum number of sessions to a value from 0 to 100.

Enabling CAC

To enable or disable CAC on a service profile, use the following command:

```
set service-profile name cac-mode {none | session}
```

For example, to enable session-based CAC on service profile *sp1*, use the following command:

```
WX1200# set service-profile sp1 cac-mode session
success: change accepted.
```

Changing the Maximum Number of Active Sessions

When CAC is enabled, the maximum number of active sessions a radio can have is 14 by default. To change the maximum number of sessions, use the following command:

```
set service-profile name cac-session max-sessions
```

The *max-sessions* can be a value from 0 to 100.

For example, to change the maximum number of sessions for radios used by service profile *sp1* to 10, use the following command:

```
WX1200# set service-profile sp1 cac-session 10
success: change accepted.
```

Configuring Static CoS

To configure static CoS for an SSID, enable the feature and set the CoS value. MAP radios that forward traffic for the SSID mark all the traffic with the static CoS value and use the corresponding forwarding queue to forward the traffic. The static CoS value applies to all traffic on the SSID.

To enable static CoS and set the CoS value, use the following commands:

```
set service-profile name static-cos {enable | disable}
set service-profile name cos level
```

The *level* can be a value from 0 (lowest priority) to 7 (highest priority). The default is 0.

For example, to configure static CoS 7 for service profile *sp1*, use the following commands:

```
WX1200# set service-profile sp1 static-cos enable
success: change accepted.
WX1200# set service-profile sp1 cos 7
success: change accepted.
```

Changing CoS Mappings

To change CoS mappings, use the following commands:

```
set qos dscp-to-cos-map dscp-range cos level
set qos cos-to-dscp-map level dscp dscp-value
```

The first command changes the mapping of ingress DSCP values to the internal QoS table when marking packets. The second command changes the mappings of the internal QoS values to DSCP value when tagging outbound packets.

The following command changes the mapping of DSCP value 45 from CoS value 5 to CoS value 7. (The change affects classification but does not affect marking.)

```
WX1200# set qos dscp-to-cos-map 45 cos 7
success: change accepted.
```

The following command changes the mapping of CoS value 6 from DSCP value 48 to DSCP value 55. (The change affects marking but does not affect classification.)

```
WX4400# set qos cos-to-dscp-map 6 dscp 55
success: change accepted.
```

Using the Client's DSCP Value to Classify QoS Level

To configure MSS to classify the QoS level of IP packets based on their DSCP value, instead of their 802.11 priority, use the following command:

```
set service-profile name use-client-dscp {enable | disable}
```

If this command is enabled in the service profile, the 802.11 QoS level is ignored, and MSS classifies QoS level of IP packets based on their DSCP value.

The following command enables mapping the QoS level of IP packets based on their DSCP value for service profile *sp1*:

```
WX# set service-profile sp1 use-client-dscp enable
success: change accepted.
```

Enabling Broadcast Control

To enable broadcast control features on a service-profile basis, using the following commands:

```
set service-profile name proxy-arp {enable | disable}
set service-profile name dhcp-restrict {enable | disable}
set service-profile name no-broadcast {enable | disable}
```

For example, to enable all these broadcast control features in service profile *sp1*, use the following commands:

```
WX1200# set service-profile sp1 proxy-arp enable
success: change accepted.
WX1200# set service-profile sp1 dhcp-restrict enable
success: change accepted.
WX1200# set service-profile sp1 no-broadcast enable
success: change accepted.
```

Displaying QoS Information

You can display the following types of information for QoS:

- Radio profile QoS settings: QoS mode
- Service profile QoS settings: CAC, static CoS, and broadcast control settings
- Broadcast control settings
- Default CoS mappings
- Individual DSCP-to-CoS or CoS-to-DSCP mappings
- The DSCP table (a reference of standard mappings from DSCP to IP ToS and IP precedence)
- QoS Statistics for the MAP forwarding queues

Displaying a Radio Profile's QoS Settings

To display the QoS mode and all other settings for a radio profile, use the following command:

```
display radio-profile {name | ?}
```

The following example shows the configuration of radio profile *rp1*.

```
WX1200# display radio-profile rp1
Beacon Interval:                  100   DTIM Interval:                  1
Max Tx Lifetime:                 2000   Max Rx Lifetime:             2000
RTS Threshold:                   2346   Frag Threshold:              2346
Long Preamble:                     no   Tune Channel:                 yes
Tune Power:                        no   Tune Channel Interval:       3600
Tune Power Interval:               600   Channel Holddown:                  300
Power Backoff Timer:                10   Countermeasures:                  none
Active-Scan:                       yes   QoS Mode:                          wmm
Service profiles: sp1
```

In this example, the QoS mode is WMM.

(For more information about this command's output, see the "MAP Commands" chapter in the *Wireless LAN Switch and Controller Configuration Guide*.)

Displaying a Service Profile's QoS Settings

To display QoS settings and all other settings for a service profile, use the following command:

```
display service-profile {name | ?}
```

The following example shows the configuration of the *sp1* service profile.

```
WX1200# display service-profile sp1
ssid-name:                       corp2   ssid-type:                      crypto
Beacon:                            yes   Proxy ARP:                          no
DHCP restrict:                      no   No broadcast:                       no
Short retry limit:                   5   Long retry limit:                    5
Auth fallthru:                    none   Sygate On-Demand (SODA):            no
Enforce SODA checks:               yes   SODA remediation ACL:
Custom success web-page:                 Custom failure web-page:
Custom logout web-page:                  Custom agent-directory:
Static COS:                         no   COS:                                 0
CAC mode:                      session   CAC sessions:                       14
User idle timeout:                 180   Idle client probing:               yes
Web Portal Session Timeout:          5
WEP Key 1 value:                <none>   WEP Key 2 value:                <none>
WEP Key 3 value:                <none>   WEP Key 4 value:                <none>
WEP Unicast Index:                   1   WEP Multicast Index:                 1
Shared Key Auth:                    NO
WPA enabled:
    ciphers: cipher-tkip
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
11a beacon rate:                   6.0   multicast rate:                   AUTO
11a mandatory rate: 6.0,12.0,24.0 standard rates: 9.0,18.0,36.0,48.0,54.0
11b beacon rate:                   2.0   multicast rate:                   AUTO
11b mandatory rate: 1.0,2.0 standard rates: 5.5,11.0
11g beacon rate:                   2.0   multicast rate:                   AUTO
11g mandatory rate: 1.0,2.0,5.5,11.0 standard rates: 6.0,9.0,12.0,18.0,24.0,
36.0,48.0,54.0
```

Configuration information for some settings appears in other chapters. To configure transmit rates, or the long or short retry, see "Configuring a Service Profile" on page 233. To configure the user-idle timeout and idle-client probing, see "Displaying and Changing Network Session Timers" on page 565.

(For more information about this command's output, see the "MAP Commands" chapter in the *Wireless LAN Switch and Controller Configuration Guide*.)

Displaying CAC Session Information

To display current CAC session counts on all MAPs using a specified service profile, when session-based CAC is enabled, use the following command:

```
display service-profile name cac session
```

The following example displays information about CAC session counts for service profile *sp1*:

```
WX# display service-profile sp1 cac session
Service Profile   sp1
CAC Mode          SESSION
Max Sessions      14
```

(For more information about this command's output, see the "MAP Commands" chapter in the *Wireless LAN Switch and Controller Configuration Guide*)

Displaying CoS Mappings

MSS provides commands for displaying the default CoS mappings and configured mappings.

Displaying the Default CoS Mappings

To display the default CoS mappings, use the following command:

```
WX1200# display qos default

Ingress QoS Classification Map (dscp-to-cos)

Ingress DSCP       CoS Level
===============================================================================
       00-09       0    0    0    0    0      0    0    0    1    1
       10-19       1    1    1    1    1      1    2    2    2    2
       20-29       2    2    2    2    3      3    3    3    3    3
       30-39       3    3    4    4    4      4    4    4    4    4
```

```
        40-49       5    5    5    5    5      5    5    5    6    6
        50-59       6    6    6    6    6      6    7    7    7    7
        60-63       7    7    7    7


Egress QoS Marking Map (cos-to-dscp)

CoS Level                0      1      2      3      4      5      6      7
===============================================================================
Egress DSCP              0      8     16     24     32     40     48     56
Egress ToS byte       0x00   0x20   0x40   0x60   0x80   0xA0   0xC0   0xE0
```

Displaying a DSCP-to-CoS Mapping

To display the CoS value to which a specific DSCP value is mapped during classification, use the following command:

```
display qos dscp-to-cos-map dscp-value
```

The following command displays the CoS value to which DSCP value 55 is mapped:

```
WX1200# display qos dscp-to-cos-map 55
dscp 55 is classified as cos 6
```

Displaying a CoS-to-DSCP Mapping

To display the DSCP value to which a specific CoS value is mapped during marking, use the following command:

```
display qos cos-to-dscp-map cos-value
```

The following command displays the DSCP value to which CoS value 6 is mapped:

```
WX1200# display qos cos-to-dscp-map 6
cos 6 is marked with dscp 48 (tos 0xC0)
```

Displaying the DSCP Table

To display the standard mappings of DSCP, ToS, and precedence values, use the following command:

```
WX1200# display qos dscp-table

DSCP           TOS            precedence    tos
dec  hex       dec  hex
-----------------------------------------------
  0  0x00        0  0x00               0      0
  1  0x01        4  0x04               0      2
  2  0x02        8  0x08               0      4
  3  0x03       12  0x0c               0      6
  4  0x04       16  0x10               0      8
  5  0x05       20  0x14               0     10
  6  0x06       24  0x18               0     12
  7  0x07       28  0x1c               0     14
  8  0x08       32  0x20               1      0
  9  0x09       36  0x24               1      2
...
 63  0x3f      252  0xfc               7     14
```

Displaying MAP Forwarding Queue Statistics

You can display statistics for MAP forwarding queues, using the following commands:

```
display ap qos-stats [apnumber] [clear]
```

The **clear** option clears the counters after displaying their values.

The following command shows statistics for the MAP forwarding queues on a Distributed MAP:

```
WX# display ap qos-stats 4
```

17

CONFIGURING AND MANAGING SPANNING TREE PROTOCOL

The purpose of the Spanning Tree Protocol (STP) is to maintain a loop-free network. A loop-free path is accomplished when a device recognizes a loop in the topology and blocks one or more redundant paths.

Overview

Mobility System Software (MSS) supports 802.1D and Per-VLAN Spanning Tree protocol (PVST+).

- MSS uses 802.1D bridge protocol data units (BPDUs) on VLAN ports that are untagged. However, each VLAN still runs its own instance of STP, even if two or more VLANs contain untagged ports. To run a single instance of STP in 802.1D mode on the entire switch, configure all network ports as untagged members of the same VLAN.
- MSS uses PVST+ BPDUs on VLAN ports that are tagged. PVST+ BPDUs include tag information in the 802.1Q field of the BPDUs. MSS runs a separate instance of PVST+ on each tagged VLAN.

STP does not run on MAP access ports or wired authentication ports and does not affect traffic flow on these port types.

When you create a VLAN, STP is disabled on the new VLAN by default, regardless of the STP state of other VLANs on the device.

The IEEE 802.1D spanning tree specifications refer to networking devices that forward Layer 2 traffic as bridges. In this context, a WX switch is a bridge. Where this manual or the product interface uses the term bridge, you can assume the term is applicable to the WX switch.

Enabling the Spanning Tree Protocol

STP is disabled by default. You can enable STP globally or on individual VLANs.

To enable STP, use the following command:

```
set spantree {enable | disable}
[{all | vlan vlan-id | port port-list vlan-id}]
```

To enable STP on all VLANs configured on a WX switch, type the following command:

```
WX1200# set spantree enable
success: change accepted.
```

To verify the STP state and display the STP parameter settings, enter the **display spantree** command. For information, see "Displaying Spanning Tree Information" on page 361.

Changing Standard Spanning Tree Parameters

You can change the following standard STP parameters:

- Bridge priority
- Port cost
- Port priority

Bridge Priority

The bridge priority determines the WX switch's eligibility to become the root bridge. You can set this parameter globally or on individual VLANs.

The root bridge is elected based on the bridge priority of each device in the spanning tree. The device with the highest bridge priority is elected to be the root bridge for the spanning tree. The bridge priority is a numeric value from 0 through 65,535. Lower numeric values represent higher priorities. The highest priority is 0, and the lowest priority is 65,535. The default bridge priority for all devices is 32,768.

If more than one device has the highest bridge priority (lowest numeric value), the device with the lowest MAC address becomes the root bridge.

If the root bridge fails, STP elects a new root bridge based on the bridge priorities of the remaining bridges.

Port Cost

Port cost is a numeric value that STP adds to the total cost of a path to the root bridge. When a designated bridge has multiple equal-cost paths to the root bridge, the designated bridge uses the path with the lowest total cost. You can set this parameter on an individual port basis, for all VLANs the port is in, or for specific VLANs.

You can specify a value from 1 through 65,535 for the port cost. The default depends on the port speed and link type. Table 29 lists the defaults for STP port path cost.

Table 29 SNMP Port Path Cost Defaults

Port Speed	Link Type	Default Port Path Cost
1000 Mbps	Full Duplex Aggregate Link (Port Group)	19
1000 Mbps	Full Duplex	4
100 Mbps	Full Duplex Aggregate Link (Port Group)	19
100 Mbps	Full Duplex	18
100 Mbps	Half Duplex	19
10 Mbps	Full Duplex Aggregate Link (Port Group)	19
10 Mbps	Full Duplex	95
10 Mbps	Half Duplex	100

Port Priority

Port priority is the eligibility of the port to be the designated port to the root bridge, and thus part of the path to the root bridge. When the WX switch has more than one link to the root bridge, STP uses the link with the lowest priority value. You can set this parameter on an individual port basis, for all VLANs the port is in, or for specific VLANs.

Specify a priority from 0 (highest priority) through 255 (lowest priority). The default is 128.

Changing the Bridge Priority

To change the bridge priority, use the following command:

```
set spantree priority value {all | vlan vlan-id}
```

Specify a bridge priority from 0 through 65,535. The default is 32,768. The **all** option applies the change globally to all VLANs. Alternatively, specify an individual VLAN.

To change the bridge priority of VLAN *pink* to 69, type the following command:

```
WX1200# set spantree priority 69 vlan pink
success: change accepted.
```

Changing STP Port Parameters

You can change the STP cost and priority of an individual port, on a global basis or an individual VLAN basis.

Changing the STP Port Cost

To change the cost of a port, use one of the following commands.

```
set spantree portcost port-list cost cost
set spantree portvlancost port-list cost cost {all | vlan
vlan-id}
```

The **set spantree portcost** command changes the cost for ports in the default VLAN (VLAN 1) only. The **set spantree portvlancost** command changes the cost for ports in a specific other VLAN or in all VLANs.

Specify a value from 1 through 65,535 for the cost. The default depends on the port speed and link type. (See Table 29 on page 353.)

The **all** option applies the change to all VLANs. Alternatively, specify an individual VLAN.

To change the cost on ports 3 and 4 in the default VLAN to 20, type the following command:

```
WX1200# set spantree portcost 3,4 cost 20
success: change accepted.
```

To change the cost for the same ports in VLAN *mauve*, type the following command:

```
WX1200# set spantree portvlancost 3,4 cost 20 vlan mauve
success: change accepted.
```

Resetting the STP Port Cost to the Default Value

To reset the STP port cost to the default value, use one of the following commands:

```
clear spantree portcost port-list
clear spantree portvlancost port-list {all | vlan vlan-id}
```

The command applies only to the ports you specify. The port cost on other ports remains unchanged.

To reset the cost of ports 3 and 4 in the default VLAN to the default value, type the following command:

```
WX1200# clear spantree portcost 3-4
success: change accepted.
```

To reset the cost of ports 3 and 4 for VLAN *beige*, type the following command:

```
WX1200# clear spantree portvlancost 3-4 vlan beige
success: change accepted.
```

Changing the STP Port Priority

To change the priority of a port, use one of the following commands:

```
set spantree portpri port-list priority value
set spantree portvlanpri port-list priority value {all |
vlan vlan-id}
```

The **set spantree portpri** command changes the priority for ports in the default VLAN (VLAN 1) only. The **set spantree portvlanpri** command changes the priority for ports in a specific other VLAN or in all VLANs.

Specify a priority from 0 (highest priority) through 255 (lowest priority). The default is 128.

The **all** option applies the change to all VLANs. Alternatively, specify an individual VLAN.

To set the priority of ports 3 and 4 in the default VLAN to 48, type the following command:

```
WX1200# set spantree portpri 3-4 priority 48
success: change accepted.
```

To set the priority of ports 3 and 4 to 48 in VLAN *mauve*, type the following command:

```
WX1200# set spantree portvlanpri 3-4 priority 48 vlan mauve
success: change accepted.
```

Resetting the STP Port Priority to the Default Value

To reset the STP port priority to the default value, use one of the following commands:

```
clear spantree portpri port-list
clear spantree portvlanpri port-list {all | vlan vlan-id}
```

The command applies only to the ports you specify. The port cost on other ports remains unchanged.

Changing the STP Port Priority

To change the priority of a port, use one of the following commands:

```
set spantree portpri port-list priority value
set spantree portvlanpri port-list priority value {all |
vlan vlan-id}
```

The **set spantree portpri** command changes the priority for ports in the default VLAN (VLAN 1) only. The **set spantree portvlanpri** command changes the priority for ports in a specific other VLAN or in all VLANs.

Specify a priority from 0 (highest priority) through 255 (lowest priority). The default is 128.

The **all** option applies the change to all VLANs. Alternatively, specify an individual VLAN.

To set the priority of ports 3 and 4 in the default VLAN to 48, type the following command:

```
WX1200# set spantree portpri 3-4 priority 48
success: change accepted.
```

To set the priority of ports 3 and 4 to 48 in VLAN *mauve*, type the following command:

```
WX1200# set spantree portvlanpri 3-4 priority 48 vlan mauve
success: change accepted.
```

Resetting the STP Port Priority to the Default Value

To reset the STP port priority to the default value, use one of the following commands:

```
clear spantree portpri port-list
clear spantree portvlanpri port-list {all | vlan vlan-id}
```

The command applies only to the ports you specify. The port cost on other ports remains unchanged.

Changing Spanning Tree Timers

You can change the following STP timers:

- **Hello interval** — The interval between configuration messages sent by a WX switch when the switch is acting as the root bridge. You can specify an interval from 1 through 10 seconds. The default is 2 seconds.
- **Forwarding delay** — The period of time a bridge other than the root bridge waits after receiving a topology change notification to begin forwarding data packets. You can specify a delay from 4 through 30 seconds. The default is 15 seconds. (The root bridge always forwards traffic.)
- **Maximum age** — The period of time that a WX switch acting as a designated bridge waits for a new hello packet from the root bridge before determining that the root bridge is no longer available and initiating a topology change. You can specify an age from 6 through 40 seconds. The default is 20 seconds.

Changing the STP Hello Interval

To change the hello interval, use the following command:

```
set spantree hello interval {all | vlan vlan-id}
```

Specify an interval from 1 through 10 seconds. The default is 2 seconds.

The **all** option applies the change to all VLANs. Alternatively, specify an individual VLAN.

To change the hello interval for all VLANs to 4 seconds, type the following command:

```
WX1200# set spantree hello 4 all
success: change accepted.
```

Changing the STP Forwarding Delay

To change the forwarding delay, use the following command:

```
set spantree fwddelay delay {all | vlan vlan-id}
```

Specify a delay from 4 through 30 seconds. The default is 15 seconds.

The **all** option applies the change to all VLANs. Alternatively, specify an individual VLAN.

To change the forwarding delay on VLAN *pink* to 20 seconds, type the following command:

```
WX1200# set spantree fwddelay 20 vlan pink
success: change accepted.
```

Changing the STP Maximum Age

To change the maximum age, use the following command:

```
set spantree maxage aging-time {all | vlan vlan-id}
```

Specify an age from 6 through 40 seconds. The default is 20 seconds.

The **all** option applies the change to all VLANs. Alternatively, specify an individual VLAN.

To change the maximum acceptable age for root bridge hello packets on all VLANs to 15 seconds, type the following command:

```
WX1200# set spantree maxage 15 all
success: change accepted.
```

Configuring and Managing STP Fast Convergence Features

The standard STP timers delay traffic forwarding briefly after a topology change. The time a port takes to change from the listening state to the learning state or from the learning state to the forwarding state is called the forwarding delay. In some configurations, this delay is unnecessary. The WX switch provides the following fast convergence features to bypass the forwarding delay:

- Port fast
- Backbone fast
- Uplink fast

Port Fast Convergence

Port fast convergence bypasses both the listening and learning stages and immediately places a port in the forwarding state. You can use port fast convergence on ports that are directly connected to servers, hosts, or other MAC stations.

Do not use port fast convergence on ports connected to other bridges.

Backbone Fast Convergence

Backbone fast convergence accelerates a port's recovery following the failure of an indirect link. Normally, when a forwarding link fails, a bridge that is not directly connected to the link does not detect the link change until the maximum age timer expires. Backbone fast convergence enables the WX switch to listen for bridge protocol data units (BPDUs) sent by a designated bridge when the designated bridge's link to the root bridge fails. The switch immediately verifies whether BPDU information stored on a port is still valid. If not, the bridge immediately starts the listening stage on the port.

CAUTION: *The backbone fast convergence feature is not compatible with switches that are running standard IEEE 802.1D Spanning Tree implementations. This includes switches running Rapid Spanning Tree or Multiple Spanning Tree.*

If you plan to use the backbone fast convergence feature, you must enable it on all the bridges in the spanning tree.

Uplink Fast Convergence

Uplink fast convergence enables a WX switch that has redundant links to the network core to immediately change the state of a backup link to forwarding if the primary link to the root fails. Uplink fast convergence bypasses the listening and learning states to immediately enter the forwarding state.

The uplink fast convergence feature is applicable to bridges that are acting as access switches to the network core (distribution layer) but are not in the core themselves. Do not enable the feature on WX switches that are in the network core.

Configuring Port Fast Convergence

To enable or disable port fast convergence, use the following command:

```
set spantree portfast port port-list {enable | disable}
```

To enable port fast convergence on ports 1, 3, and 5, type the following command:

```
WX1200# set spantree portfast port 1,3,5 enable
success: change accepted.
```

Displaying Port Fast Convergence Information

To display port fast convergence information, use the following command:

```
display spantree portfast [port-list]
```

To display port fast convergence information for all ports, type the following command:

```
WX1200# display spantree portfast
Port                       Vlan   Portfast
-------------------------- ----   ----------
1                            1    disable
2                            1    disable
3                            1    disable
4                            1    enable
7                            1    disable
8                            1    disable
5                            2    enable
6                            2    enable
```

In this example, port fast convergence is enabled on ports 5 and 6 in VLAN 2 and port 4 in VLAN 1.

Configuring Backbone Fast Convergence

To enable or disable backbone fast convergence, use the following command:

```
set spantree backbonefast {enable | disable}
```

To enable backbone fast convergence on all VLANs, type the following command:

```
WX1200# set spantree backbonefast enable
success: change accepted.
```

Displaying the Backbone Fast Convergence State

To display the state of the backbone fast convergence feature, use the following command:

```
display spantree backbonefast
```

Here is an example:

```
WX1200# display spantree backbonefast



 Backbonefast is enabled
```

In this example, backbone fast convergence is enabled.

Configuring Uplink Fast Convergence

To enable or disable uplink fast convergence, use the following command:

```
set spantree uplinkfast {enable | disable}
```

Displaying Uplink Fast Convergence Information

To display uplink fast convergence information, use the following command:

```
display spantree uplinkfast [vlan vlan-id]
```

The following command displays uplink fast convergence information for all VLANs:

```
WX1200# display spantree uplinkfast
VLAN    port    list
------------------------------------------------------------
1       1(fwd),2,3
```

In this example, ports 1, 2, and 3 provide redundant links to the network core. Port 1 is forwarding traffic. The remaining ports block traffic to prevent a loop.

Displaying Spanning Tree Information

You can use CLI commands to display the following STP information:

- Bridge STP settings and individual port information
- Blocked ports
- Statistics
- Port fast, backbone fast, and uplink fast convergence information

*For information about the **display** commands for the fast convergence features, see “Configuring and Managing STP Fast Convergence Features” on page 358.*

Displaying STP Bridge and Port Information

To display STP bridge and port information, use the following command:

```
display spantree [port port-list | vlan vlan-id] [active]
```

By default, STP information for all ports and all VLANs is displayed. To display STP information for specific ports or a specific VLAN only, enter a port list or a VLAN name or number. For each VLAN, only the ports contained in the VLAN are listed in the command output.

To list only the ports that are in the active (forwarding) state, enter the **active** option.

To display STP information for VLAN *mauve*, type the following command:

```
WX1200# display spantree vlan mauve
VLAN     3
Spanning tree mode           PVST+
Spanning tree type           IEEE
Spanning tree enabled

Designated Root               00-02-4a-70-49-f7
Designated Root Priority      32768
Designated Root Path Cost    19
Designated Root Port         1
Root Max Age   20 sec    Hello Time 2 sec   Forward Delay 15 sec
Bridge ID MAC ADDR           00-0b-0e-02-76-f7
Bridge ID Priority           32768
Bridge Max Age 20 sec   Hello Time 2 sec   Forward Delay 15 sec
Port               Vlan       STP-State     Cost   Prio   Portfast
------------------------------------------------------------------------------
1                   1          Forwarding         19      128   Disabled
2                   1          Blocking           19      128   Disabled
3                   1          Blocking           19      128   Disabled
5                   1          Forwarding         19      128   Disabled
6                   1          Blocking           19      128   Disabled
```

In this example, VLAN *mauve* contains ports 1 through 3, 5 and 6. Ports 1 and 5 are forwarding traffic. The other ports are blocking traffic.

(For more information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying the STP Port Cost on a VLAN Basis

To display a brief list of the STP port cost for a port in each of its VLANs, use the following command:

```
display spantree portvlancost port-list
```

This command displays the same information as the **display spantree** command's Cost field in a concise format for all VLANs. The **display spantree** command lists all the STP information separately for each VLAN.

To display the STP port cost of port 1, type the following command:

```
WX1200# display spantree portvlancost 1
port 1 VLAN 1 have path cost 19
```

Displaying Blocked STP Ports

To display information about ports that are in the STP blocking state, use the following command:

```
display spantree blockedports [vlan vlan-id]
```

To display information about blocked ports on a WX switch for the *default* VLAN (VLAN 1), type the following command:

```
WX1200# display spantree blockedports vlan default
Port  Vlan   STP-State  Cost     Prio      Portfast
-------------------------------------------------------------------------
2     190      Blocking  4        128       Disabled

Number of blocked ports (segments) in VLAN 1 : 1
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Spanning Tree Statistics

To display STP statistics, use the following command:

```
display spantree statistics [port-list [vlan vlan-id]]
```

To display STP statistics for port 1, type the following command:

```
WX1200# display spantree statistics 1

BPDU related parameters


Port 1                    VLAN 1
spanning tree enabled for VLAN = 1
port spanning tree                      enabled
state                                   Forwarding
port_id                                   0x8015
port_number                               0x15
path cost                                 0x4
message age (port/VLAN)                   0(20)
designated_root                          00-0b-0e-00-04-30
designated cost                           0x0
designated_bridge                         00-0b-0e-00-04-30
designated_port                            38
top_change_ack                            FALSE
config_pending                            FALSE
port_inconsistency                        none
```

```
             Port based information statistics

config BPDU's xmitted(port/VLAN)         0 (1)
config BPDU's received(port/VLAN)    21825 (43649)
tcn BPDU's xmitted(port/VLAN)            0 (0)
tcn BPDU's received(port/VLAN)           2 (2)
forward transition count (port/VLAN)     1 (1)
scp failure count                        0
root inc trans count (port/VLAN)         1 (1)
inhibit loopguard                        FALSE
loop inc trans count                     0 (0)


              Status of Port Timers

forward delay timer                      INACTIVE
forward delay timer value                15
message age timer                        ACTIVE
message age timer value                  0
topology change timer                    INACTIVE
topology change timer value              0
hold timer                               INACTIVE
hold timer value                         0
delay root port timer                    INACTIVE
delay root port timer value              0
delay root port timer restarted is       FALSE


             VLAN based information & statistics

spanning tree type                       ieee
spanning tree multicast address          01-00-0c-cc-cc-cd
bridge priority                          32768
bridge MAC address                       00-0b-0e-12-34-56
bridge hello time                        2
bridge forward delay                     15
topology change initiator:               0
last topology change occurred:           Tue Jul 01 2003
22:33:36.
topology change                          FALSE
topology change time                     35
topology change detected                 FALSE
topology change count                    1
topology change last recvd. from         00-0b-0e-02-76-f6
```

```
             Other port specific info

dynamic max age transition               0
port BPDU ok count                       21825
msg age expiry count                     0
link loading                             0
BPDU in processing                       FALSE
num of similar BPDU's to process         0
received_inferior_bpdu                   FALSE
next state                               0
src MAC count                            21807
total src MAC count                      21825
curr_src_mac                             00-0b-0e-00-04-30
next_src_mac                             00-0b-0e-02-76-f6
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Clearing STP Statistics

To clear the STP statistics counters, use the following command.

clear spantree statistics *port-list* [**vlan** *vlan-id*]

As soon as you enter the command, MSS resets the STP counters for the specified ports or VLANs to 0. The software then begins incrementing the counters again.

Spanning Tree Configuration Scenario

This scenario configures a VLAN named *backbone* for a WX switch's connections to the network backbone, adds ports 1 and 2 to the VLAN, and enables STP on the VLAN to prevent loops.

1. Remove the network cables from ports 21 and 22 or use MSS to disable the ports. This prevents a loop until you complete the STP configuration. To disable the ports and verify the results, type the following commands:

```
WX1200# set port disable 1-2
success: set "disable" on port 1-2
WX1200# display port status
Port  Name  Admin  Oper    Config   Actual   Type    Media
==========================================================
1          down    down    auto              network
2          down    down    auto              network
3          up    down    auto    network    10/100BaseTx
4          up    down    auto    network    10/100BaseTx
5          up    down    auto    network    10/100BaseTx
6          up    down    auto    network    10/100BaseTx
```

```
7          up    down    auto    network    10/100BaseTx
8          up    down    auto    network    10/100BaseTx
```

2 Configure a *backbone* VLAN and verify the configuration change. Type the following commands:

```
WX1200# set vlan 10 name backbone port 1-2
success: change accepted.
WX1200# display vlan config
                     Admin  VLAN  Tunl                        Port
VLAN Name            Status State Affin Port            Tag   State
---- --------------- ------ ----- ----- --------------- ----- -----
   1 default         Up     Up        5
                                        1               none  Up
  10 backbone        Up     Down      5
                                        1               none  Down
                                        2               none  Down
4094 web-aaa          Up     Up        0
                                         2                 4094 Up
```

3 Enable STP on the *backbone* VLAN and verify the change. Type the following commands:

```
WX1200# set spantree enable vlan backbone
success: change accepted.
WX1200# display spantree vlan 10

VLAN    10
Spanning tree mode           PVST+
Spanning tree type           IEEE
Spanning tree enabled

Designated Root              00-0b-0e-00-04-0c
Designated Root Priority     32768
Designated Root Path Cost    0
We are the root
Root Max Age   20 sec   Hello Time 2 sec   Forward Delay 15 sec
Bridge ID MAC ADDR           00-0b-0e-00-04-0c
Bridge ID Priority           32768
Bridge Max Age 20 sec   Hello Time 2 sec   Forward Delay 15 sec

Port               Vlan       STP-State    Cost   Prio   Portfast
--------------------------------------------------------------------
1                  10        Disabled         4   128     Disabled
2                  10        Disabled         4   128     Disabled
```

4 Reconnect or reenable ports 21 and 22 and verify the change. Type the following commands:

```
WX1200# set port enable 1-2
success: set "enable" on port 1-2
WX1200# display port status
Port  Name             Admin  Oper    Config    Actual    Type       Media
===============================================================================
1                      up     up      auto      1000/full network
2                      up     up      auto      1000/full network
3                      up     down    auto                network    10/100BaseTx
4                      up     down    auto                network    10/100BaseTx
5                      up     down    auto                network    10/100BaseTx
6                      up     down    auto                network    10/100BaseTx
7                      up     down    auto                network    10/100BaseTx
8                      up     down    auto                network    10/100BaseTx
```

5 Wait for STP to complete the listening and learning stages and converge, then verify that STP is operating properly and blocking one of the ports in the *backbone* VLAN. Type the following command:

```
WX1200# display spantree vlan 10

VLAN    10
Spanning tree mode            PVST+
Spanning tree type            IEEE
Spanning tree enabled

Designated Root               00-0b-0e-00-04-0c
Designated Root Priority      32768
Designated Root Path Cost     0
We are the root
Root Max Age   20 sec   Hello Time 2 sec   Forward Delay 15 sec
Bridge ID MAC ADDR            00-0b-0e-00-04-0c
Bridge ID Priority            32768
Bridge Max Age 20 sec   Hello Time 2 sec   Forward Delay 15 sec

Port       Vlan       STP-State    Cost   Prio   Portfast
-------------------------------------------------------------------------
1          10         Forwarding      4   128     Disabled
2          10         Blocking        4   128     Disabled
```

6 Save the configuration. Type the following command:

```
WX1200# save config
success: configuration saved.
```

18 CONFIGURING AND MANAGING IGMP SNOOPING

Internet Group Management Protocol (IGMP) snooping controls multicast traffic on a WX switch by forwarding packets for a multicast group only on the ports that are connected to members of the group. A multicast group is a set of IP hosts that receive traffic addressed to a specific Class D IP address, the group address.

Overview

The WX switch listens for multicast packets and maintains a table of multicast groups, as well as their sources and receivers, based on the traffic. IGMP snooping is enabled by default.

You can configure IGMP snooping parameters and enable or disable the feature on an individual VLAN basis.

The current software version supports IGMP versions 1 and 2.

Disabling or Reenabling IGMP Snooping

IGMP snooping is enabled by default. To disable or reenable the feature, use the following command:

```
set igmp {enable | disable} [vlan vlan-id]
```

If you do not specify a VLAN ID, the change is applied to all VLANs on the WX switch.

Disabling or Reenabling Proxy Reporting

Proxy reporting reduces multicast overhead by sending only one report for each active group to the multicast routers, instead of sending a separate report from each multicast receiver. For example, if the WX switch receives reports from three receivers for multicast group 237.255.255.255, the switch sends only one report for the group to the routers. One report is sufficient to cause the routers to continue sending data for the group. Proxy reporting is enabled by default.

To disable or reenable proxy reporting, use the following command:

```
set igmp proxy-report {enable | disable} [vlan vlan-id]
```

Enabling the Pseudo-Querier

The IGMP pseudo-querier enables IGMP snooping to operate in a VLAN that does not have a multicast router to send IGMP general queries to clients.

3Com recommends that you use the pseudo-querier only when the VLAN contains local multicast traffic sources and no multicast router is servicing the subnet.

To enable the pseudo-querier, use the following command:

```
set igmp querier {enable | disable} [vlan vlan-id]
```

Changing IGMP Timers

You can change the following IGMP timers:

- **Query interval** — Number of seconds that elapse between general queries sent by the WX switch to advertise multicast groups.
- **Other-querier-present interval** — Number of seconds that the WX switch waits for a general query to arrive from another querier before electing itself the querier.
- **Query response interval** — Number of tenths of a second that the WX switch waits for a receiver to respond to a group-specific query message before removing the receiver from the receiver list for the group.

The query interval, other-querier-present interval, and query response interval are applicable only when the WX switch is querier for the subnet. For the switch to become the querier, the pseudo-querier feature must be enabled on the switch and the switch must have the lowest IP address among all the devices eligible to become a querier. To enable the pseudo-querier feature, see "Enabling the Pseudo-Querier" on page 370.

- **Last member query interval** — Number of tenths of a second that the WX switch waits for a response to a group-specific query after receiving a leave message for that group, before removing the receiver that sent the leave message from the list of receivers for the group. If there are no more receivers for the group, the switch also sends a leave message for the group to multicast routers.
- **Robustness value** — Number used as a multiplier to adjust the IGMP timers to the amount of traffic loss that occurs on the network. Set the robustness value higher to adjust for more traffic loss.

Changing the Query Interval

To change the IGMP query interval timer, use the following command:

```
set igmp qi seconds [vlan vlan-id]
```

For *seconds*, you can specify a value from 1 through 65,535. The default is 125 seconds.

Changing the Other-Querier-Present Interval

To change the other-querier-present interval, use the following command:

```
set igmp oqi seconds [vlan vlan-id]
```

For *seconds*, you can specify a value from 1 through 65,535. The default is 255 seconds.

Changing the Query Response Interval

To set the query response interval, use the following command:

```
set igmp qri tenth-seconds [vlan vlan-id]
```

You can specify a value from 1 through 65,535 tenths of a second. The default is 100 tenths of a second (10 seconds).

Changing the Last Member Query Interval

To set the last member query interval, use the following command:

```
set igmp lmqi tenth-seconds [vlan vlan-id]
```

You can specify a value from 1 through 65,535 tenths of a second. The default is 10 tenths of a second (1 second).

Changing Robustness

Robustness adjusts the IGMP timers to the amount of traffic loss that occurs on the network. Set the robustness value higher to adjust for more traffic loss. To change the robustness value, use the following command:

```
set igmp rv num [vlan vlan-id]
```

You can specify a value from 2 through 255. The default is 2.

Enabling Router Solicitation

A WX switch can search for multicast routers by sending multicast router solicitation messages. This message invites multicast routers that receive the message and that support router solicitation to immediately advertise themselves to the WX switch. Router solicitation is disabled by default.

The MSS implementation of router solicitation is based on *draft-ietf-idmr-igmp-mrdisc-09.txt*.

To enable or disable multicast router solicitation, use the following command:

```
set igmp mrsol {enable | disable} [vlan vlan-id]
```

Changing the Router Solicitation Interval

The default multicast router solicitation interval is 30 seconds. To change the interval, use the following command:

```
set igmp mrsol mrsi seconds [vlan vlan-id]
```

You can specify 1 through 65,535 seconds. The default is 30 seconds.

Configuring Static Multicast Ports

A WX switch learns about multicast routers and receivers from multicast traffic it receives from those devices. When the WX switch receives traffic from a multicast router or receiver, the switch adds the port that received the traffic as a multicast router or receiver port. The WX switch forwards traffic to multicast routers only on the multicast router ports and forwards traffic to multicast receivers only on the multicast receiver ports.

The router and receiver ports that the WX switch learns based on multicast traffic age out if they are unused.

You can add network ports as static multicast router ports or multicast receiver ports. Ports you add do not age out.

You cannot add MAP access ports or wired authentication ports as static multicast ports. However, MSS can dynamically add these port types to the list of multicast ports based on multicast traffic.

Adding or Removing a Static Multicast Router Port

To add or remove a static multicast router port, use the following command:

```
set igmp mrouter port port-list {enable | disable}
```

Adding or Removing a Static Multicast Receiver Port

To add a static multicast receiver port, use the following command:

```
set igmp receiver port port-list {enable | disable}
```

Displaying Multicast Information

You can use the CLI to display the following IGMP snooping information:

- Multicast configuration information and statistics
- Multicast queriers
- Multicast routers
- Multicast receivers

Displaying Multicast Configuration Information and Statistics

To display multicast configuration information and statistics, use the following command:

```
display igmp [vlan vlan-id]
```

The **display igmp** command displays the IGMP snooping state, the settings of all multicast parameters you can configure, and multicast statistics.

To display multicast information for VLAN *orange*, type the following command:

```
WX1200# display igmp vlan orange
VLAN: orange
IGMP is enabled
Proxy reporting is on
Mrouter solicitation is on
Querier functionality is off
Configuration values: qi: 125 oqi: 300 qri: 100 lmqi: 10 rvalue: 2 Multicast
router information:
Port Mrouter-IPaddr Mrouter-MAC       Type  TTL
---- --------------- ----------------- ----- -----
   1      192.28.7.5 00:01:02:03:04:05 dvmrp    17
Group           Port Receiver-IP     Receiver-MAC      TTL
--------------- ---- --------------- ----------------- -----
      224.0.0.2 none none            none              undef
237.255.255.255    5     10.10.10.11 00:02:04:06:08:0b   258
```

```
237.255.255.255    5     10.10.10.13 00:02:04:06:08:0d   258
237.255.255.255    5     10.10.10.14 00:02:04:06:08:0e   258
237.255.255.255    5     10.10.10.12 00:02:04:06:08:0c   258
237.255.255.255    5     10.10.10.10 00:02:04:06:08:0a   258
                   Querier information:
                   Querier for vlan orange
Port Querier-IP      Querier-MAC       TTL
---- --------------- ----------------- -----
   1 193.122.135.178 00:0b:cc:d2:e9:b4    23
IGMP vlan member ports: 1,2, 4, 6, 5, 3, 8
IGMP static ports: none
IGMP statistics for vlan orange:
IGMP message type Received Transmitted Dropped
----------------- -------- ----------- -------
General-Queries          0           0       0
GS-Queries               0           0       0
Report V1                0           0       0
Report V2                5           1       4
Leave                    0           0       0
Mrouter-Adv              0           0       0
Mrouter-Term             0           0       0
Mrouter-Sol             50         101       0
DVMRP                    4           4       0
PIM V1                   0           0       0
PIM V2                   0           0       0
Topology notifications: 0
Packets with unknown IGMP type: 0
Packets with bad length: 0
Packets with bad checksum: 0
Packets dropped: 4
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Multicast Statistics Only

To display multicast statistics only without also displaying all the other multicast information, use the following command:

```
display igmp statistics [vlan vlan-id]
```

Clearing Multicast Statistics

To clear the multicast statistics counters, use the following command:

```
clear igmp statistics [vlan vlan-id]
```

The counters begin incrementing again, starting from 0.

Displaying Multicast Queriers

To display information about the multicast querier only without also displaying all the other multicast information, use the following command:

```
display igmp querier [vlan vlan-id]
```

To display querier information for VLAN *orange*, type the following command:

```
WX1200# display igmp querier vlan orange
Querier for vlan orange
Port Querier-IP      Querier-MAC       TTL
---- --------------- ----------------- -----
   1 193.122.135.178 00:0b:cc:d2:e9:b4   23
```

In this example, the pseudo-querier feature is enabled on VLAN orange.

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Multicast Routers

To display information about the multicast routers only without also displaying all the other multicast information, use the following command:

```
display igmp mrouter [vlan vlan-id]
```

To display the multicast routers in VLAN *orange*, type the following command:

```
WX1200# display igmp mrouter vlan orange
Multicast routers for vlan orange
Port Mrouter-IPaddr  Mrouter-MAC       Type  TTL
---- --------------- ----------------- ----- -----
   6      192.28.7.5 00:01:02:03:04:05 dvmrp    33
```

(For information about the fields in this display, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Multicast Receivers

To display information about the multicast receivers only without also displaying all the other multicast information, use the following command:

```
display igmp receiver-table [vlan vlan-id]
[group group-ip-addr/mask-length]
```

Use the **group** parameter to display receivers for a specific group or set of groups. For example, to display receivers for multicast groups 237.255.255.1 through 237.255.255.255, in all VLANs, type the following command:

```
WX1200# display igmp receiver-table group 237.255.255.0/24
VLAN: red
Session          Port Receiver-IP     Receiver-MAC      TTL
---------------- ---- --------------- ----------------- -----
237.255.255.2       2     10.10.20.19 00:02:04:06:09:0d   112
237.255.255.119     3     10.10.30.31 00:02:04:06:01:0b   112

VLAN: green
Session          Port Receiver-IP     Receiver-MAC      TTL
---------------- ---- --------------- ----------------- -----
237.255.255.17      4     10.10.40.41 00:02:06:08:02:0c    12
237.255.255.255     6     10.10.60.61 00:05:09:0c:0a:01   111
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

19

CONFIGURING AND MANAGING SECURITY ACLS

A security access control list (ACL) filters packets for the purpose of discarding them, permitting them, or permitting them with modification (marking) for class-of-service (CoS) priority treatment. A typical use of security ACLs is to enable users to send and receive packets within the local intranet, but restrict incoming packets to the server in which confidential salary information is stored.

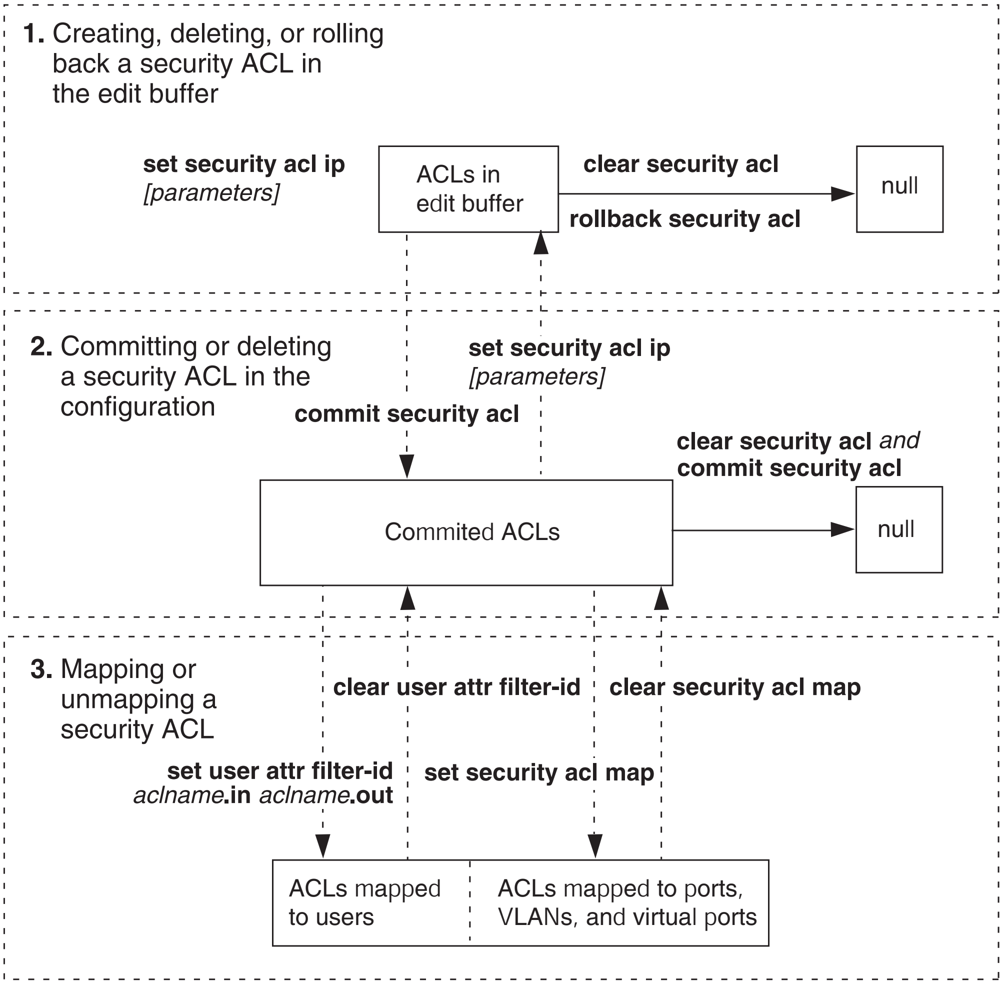
About Security Access Control Lists

3Com provides a very powerful mapping application for security ACLs. In addition to being assigned to physical ports, VLANs, virtual ports in a VLAN, or Distributed MAPs, ACLs can be mapped dynamically to a user's session, based on authorization information passed back from the AAA server during the user authentication process.

Overview of Security ACL Commands

Figure 29 provides a visual overview of the way you use MSS commands to set a security ACL, commit the ACL so it is stored in the configuration, and map the ACL to a user session, VLAN, port, virtual port, or Distributed MAP.

Figure 29 Setting Security ACLs


1. Creating, deleting, or rolling back a security ACL in the edit buffer
set security acl ip [parameters]
ACLs in edit buffer
clear security acl
rollback security acl
null
2. Committing or deleting a security ACL in the configuration
set security acl ip [parameters]
commit security acl
clear security acl and commit security acl
Commited ACLs
null
3. Mapping or unmapping a security ACL
clear user attr filter-id
clear security acl map
set user attr filter-id aclname.in aclname.out
set security acl map
ACLs mapped to users
ACLs mapped to ports, VLANs, and virtual ports

Security ACL Filters

A security ACL filters packets to restrict or permit network traffic. These filters can then be mapped by name to authenticated users, ports, VLANs, virtual ports, or Distributed MAPs. You can also assign a class-of-service (CoS) level that marks the packets matching the filter for priority handling.

A security ACL contains an ordered list of rules called access control entries (ACEs), which specify how to handle packets. An ACE contains an action that can deny the traffic, permit the traffic, or permit the traffic and apply to it a specific CoS level of packet handling. The filter can include source and destination IP address information along with other Layer 3 and Layer 4 parameters. Action is taken only if the packet matches the filter.

The order in which ACEs are listed in an ACL is important. MSS applies ACEs that are higher in the list before ACEs lower in the list. (See "Modifying a Security ACL" on page 394.) An implicit "deny all" rule is always processed as the last ACE of an ACL. If a packet matches no ACE in the entire mapped ACL, the packet is rejected. If the ACL does not contain at least one ACE that permits access, no traffic is allowed.

Plan your security ACL maps to ports, VLANs, virtual ports, and Distributed MAPs so that only one security ACL filters a given flow of packets. If more than one security ACL filters the same traffic, MSS applies only the first ACL match and ignores any other matches. Security ACLs that are mapped to users have precedence over ACLs mapped to ports, VLANs, virtual ports, or Distributed MAPs.

You cannot perform ACL functions that include permitting, denying, or marking with a Class of Service (CoS) level on packets with a multicast or broadcast destination address.

Order in Which ACLs are Applied to Traffic

MSS provides different scopes (levels of granularity) for ACLs. You can apply an ACL to any of the following scopes:

- User
- VLAN
- Virtual port (physical ports plus specific VLAN tags)
- Physical Port (network ports or Distributed MAPs)

MSS begins comparing traffic to ACLs in the order the scopes are listed above. If an ACL is mapped to more than one of these scopes, the first ACL that matches the packet is applied and MSS does not compare the packet to any more ACLs. For example, if different ACLs are mapped to both a user and a VLAN, and a user's traffic can match both ACLs, only the ACL mapped to the user is applied.

Traffic Direction

An ACL can be mapped at any scope to either the inbound traffic direction or the outbound traffic direction. It is therefore possible for two ACLs to be applied to the same traffic as it traverses the system: one ACL is applied on the inbound direction and the other is applied on the outbound direction. When you map an ACL to one of the scopes listed above, you also specify the traffic direction to which the ACL applies.

Selection of User ACLs

Identity-based ACLs (ACLs mapped to users) take precedence over location-based ACLs (ACLs mapped to VLANs, ports, virtual ports, or Distributed MAPs).

ACLs can be mapped to a user in the following ways:

- Location policy (**inacl** or **outacl** is configured on the location policy)
- User group (**attr filter-id** *acl-name***.in** or **attr filter-id** *acl-name***.out** is configured on the user group)
- Individual user attribute (**attr filter-id** *acl-name***.in** or **attr filter-id** *acl-name***.out** is configured on the individual user)
- SSID default (**attr filter-id** *acl-name***.in** or **attr filter-id** *acl-name***.out** is configured on the SSID's service profile)

The user's ACL comes from only one of these sources. The sources are listed in order from highest precedence to lowest precedence. For example, if a user associates with an SSID that has a default ACL configured, but a location policy is also applicable to the user, the ACL configured on the location policy is used.

Creating and Committing a Security ACL

The security ACLs you create can filter packets by source address, IP protocol, port type, and other characteristics. When you configure an ACE for a security ACL, MSS stores the ACE in the edit buffer until you commit the ACL to be saved to the permanent configuration. You must commit a security ACL before you can apply it to an authenticated user's session or map it to a port, VLAN, virtual port, or Distributed MAP. Every security ACL must have a name.

Setting a Source IP ACL

You can create an ACE that filters packets based on the source IP address and optionally applies CoS packet handling. (For CoS details, see "Class of Service" on page 382.) You can also determine where the ACE is placed in the security ACL by using the **before** *editbuffer-index* or **modify** *editbuffer-index* variables with an index number. You can use the **hits** counter to track how many packets the ACL filters.

The simplest security ACL permits or denies packets from a source IP address:

```
set security acl ip acl-name {permit [cos cos] | deny}
source-ip-addr mask | any} [before editbuffer-index | modify
editbuffer-index] [hits]
```

For example, to create ACL *acl-1* that permits all packets from IP address 192.168.1.4, type the following command:

```
WX1200# set security acl ip acl-1 permit 192.168.1.4 0.0.0.0
```

With the following basic security ACL command, you can specify any of the protocols supported by MSS:

```
set security acl ip acl-name {permit [cos cos] | deny}
{protocol-number} {source-ip-addr mask | any} [[precedence
precedence] [tos tos] [dscp codepoint]] [before
editbuffer-index | modify editbuffer-index] [hits]
```

The following sample security ACL permits all Generic Routing Encapsulation (GRE) packets from source IP address 192.168.1.11 to destination IP address 192.168.1.15, with a precedence level of 0 (routine), and a type-of-service (TOS) level of 0 (normal). (For more information about type-of-service and precedence levels, see the *Wireless LAN Switch and Controller Command Reference*.) GRE is protocol number 47.

```
WX1200# set security acl ip acl-2 permit cos 2 47
192.168.1.11 0.0.0.0 192.168.1.15 0.0.0.0 precedence 0 tos 0
hits
```

The security ACL *acl-2* described above also applies the CoS level 2 (medium priority) to the permitted packets. (For CoS details, see "Class of Service" on page 382.) The keyword **hits** counts the number of times this ACL affects packet traffic.

Table 30 lists common IP protocol numbers. (For a complete list of IP protocol names and numbers, see www.iana.org/assignments/protocol-numbers.) For commands that set security ACLs for specific protocols, see the following information:

- "Setting an ICMP ACL" on page 383
- "Setting a TCP ACL" on page 385
- "Setting a UDP ACL" on page 386

Table 30 Common IP Protocol Numbers

Number	Protocol
1	Internet Message Control Protocol (ICMP)
2	Internet Group Management Protocol (IGMP)
6	Transmission Control Protocol (TCP)
9	Any private interior gateway (used by Cisco for Internet Gateway Routing Protocol)
17	User Datagram Protocol (UDP)
46	Resource Reservation Protocol (RSVP)
47	Generic Routing Encapsulation (GRE) protocol
50	Encapsulation Security Payload for IPSec (IPSec-ESP)
51	Authentication Header for IPSec (IPSec-AH)
55	IP Mobility (Mobile IP)
88	Enhanced Interior Gateway Routing Protocol (EIGRP)
89	Open Shortest Path First (OSPF) protocol
103	Protocol Independent Multicast (PIM) protocol
112	Virtual Router Redundancy Protocol (VRRP)
115	Layer Two Tunneling Protocol (L2TP)

Wildcard Masks

When you specify source and destination IP addresses in an ACE, you must also include a mask for each in the form *source-ip-addr mask* and *destination-ip-addr mask.*

The mask is a wildcard mask. The security ACL checks the bits in IP addresses that correspond to any *0*s (zeros) in the mask, but does not check the bits that correspond to *1*s (ones) in the mask. Specify the IP address and wildcard mask in dotted decimal notation. For example, the IP address and wildcard mask 10.0.0.0 and 0.255.255.255 match all IP addresses that begin with 10 in the first octet.

Class of Service

Class-of-service (CoS) assignment determines the priority treatment of packets transmitted by a WX switch, corresponding to a forwarding queue on the MAP. Table 31 shows the results of CoS priorities you assign in security ACLs.

Table 31 Class-of-Service (CoS) Packet Handling

Packet Priority Desired	CLI CoS Value to Enter
Background	**1** or **2**
Best effort	**0** or **3**
Video	**4** or **5**
Voice	**6** or **7**

MAP forwarding prioritization occurs automatically for Wi-Fi Multimedia (WMM) traffic. You do not need to configure ACLs to provide WMM prioritization. For non-WMM devices, you can provide MAP forwarding prioritization by configuring ACLs.

If you disable WMM, MAP forwarding prioritization is optimized for SpectraLink Voice Priority (SVP) instead of WMM, and the MAP does not tag packets it sends to the WX. Otherwise, the classification and tagging described in "Displaying QoS Information" on page 345 remain in effect.

If you plan to use SVP or another non-WMM type of prioritization, you must configure ACLs to tag the packets. (See "Enabling Prioritization for Legacy Voice over IP" on page 401.)

Optionally, for WMM or non-WMM traffic, you can use ACLs to change the priority of traffic sent to a MAP or VLAN. (To change CoS for WMM or non-WMM traffic, see "Using ACLs to Change CoS" on page 399.)

Setting an ICMP ACL

With the following command, you can use security ACLs to set Internet Control Message Protocol (ICMP) parameters for the **ping** command:

```
set security acl ip acl-name {permit [cos cos] | deny}
icmp {source-ip-addr mask | any} {destination-ip-addr mask|
any} [type icmp-type] [code icmp-code] [precedence
precedence] [tos tos] | [dscp codepoint]] [before
editbuffer-index | modify editbuffer-index] [hits]
```

An ICMP ACL can filter packets by source and destination IP address, TOS level, precedence, ICMP type, and ICMP code. For example, the following command permits all ICMP packets coming from 192.168.1.3 and going to 192.168.1.4 that also meet the following conditions:

- ICMP type is 11 (Time Exceeded).
- ICMP code is 0 (Time to Live Exceeded).

- Type-of-service level is 12 (minimum delay plus maximum throughput).
- Precedence is 7 (network control).

```
WX1200# set security acl ip acl-3 permit icmp 192.168.1.3
0.0.0.0 192.168.1.4 0.0.0.0 type 11 code 0 precedence 7
tos 12 before 1 hits
```

The **before 1** portion of the ACE places it before any others in the ACL, so it has precedence over any later ACEs for any parameter settings that are met.

For more information about changing the order of ACEs or otherwise modifying security ACLs, see "Modifying a Security ACL" on page 394. For information about TOS and precedence levels, see the *Wireless LAN Switch and Controller Command Reference*. For CoS details, see "Class of Service" on page 382.

ICMP includes many messages that are identified by a *type* field. Some also have a code within that type. Table 32 lists some common ICMP types and codes. For more information, see www.iana.org/assignments/icmp-parameters.

Table 32 Common ICMP Message Types and Codes

ICMP Message Type (Number)	ICMP Message Code (Number)
Echo Reply (0)	None
Destination Unreachable (3)	▪ Network Unreachable (0) ▪ Host Unreachable (1) ▪ Protocol Unreachable (2) ▪ Port Unreachable (3) ▪ Fragmentation Needed (4) ▪ Source Route Failed (5)
Source Quench (4)	None
Redirect (5)	▪ Network Redirect (0) ▪ Host Redirect (1) ▪ Type of Service (TOS) and Network Redirect (2) ▪ TOS and Host Redirect (3)
Echo (8)	None

Table 32 Common ICMP Message Types and Codes (continued)

ICMP Message Type (Number)	ICMP Message Code (Number)
Time Exceeded (11)	- Time to Live (TTL) Exceeded (0) - Fragment Reassembly Time Exceeded (1)
Parameter Problem (12)	None
Timestamp (13)	None
Timestamp Reply (14)	None
Information Request (15)	None
Information Reply (16)	None

Setting TCP and UDP ACLs

Security ACLs can filter TCP and UDP packets by source and destination IP address, precedence, and TOS level. You can apply a TCP ACL to established TCP sessions only, not to new TCP sessions. In addition, security ACLs for TCP and UDP can filter packets according to a source port on the source IP address and/or a destination port on the destination IP address, if you specify a port number and an operator in the ACE. (For a list of TCP and UDP port numbers, see www.iana.org/assignments/port-numbers.)

The operator indicates whether to filter packets arriving from or destined for a port whose number is equal to (**eq**), greater than (**gt**), less than (**lt**), not equal to (**neq**), or in a range that includes (**range**) the specified port. To specify a range of TCP or UDP ports, you enter the beginning and ending port numbers.

The CLI does not accept port names in ACLs. To filter on ports by name, you must use 3Com Wireless Switch Manager. For more information, see the Wireless Switch Manager Reference Manual.

Setting a TCP ACL

The following command filters TCP packets:

```
set security acl ip acl-name {permit [cos cos] | deny}
tcp {source-ip-addr mask | any} [operator port [port2]]
{destination-ip-addr mask | any [operator port [port2]]}
[[precedence precedence] [tos tos] | [dscp codepoint]]
[established] [before editbuffer-index | modify
editbuffer-index] [hits]
```

For example, the following command permits packets sent from IP address 192.168.1.5 to 192.168.1.6 with the TCP destination port equal to 524, a precedence of 7, and a type of service of 15, on an established TCP session, and counts the number of hits generated by the ACE:

```
WX1200# set security acl ip acl-4 permit tcp
192.168.1.5 0.0.0.0 192.168.1.6 0.0.0.0 eq 524
precedence 7 tos 15 established hits
```

(For information about TOS and precedence levels, see the *Wireless LAN Switch and Controller Command Reference*. For CoS details, see "Class of Service" on page 382.)

Setting a UDP ACL

The following command filters UDP packets:

```
set security acl ip acl-name {permit [cos cos] | deny}
udp {source-ip-addr mask | any [operator port [port2]]}
{destination-ip-addr mask | any [operator port [port2]]}
[[precedence precedence] [tos tos] [dscp codepoint]] [before
editbuffer-index | modify editbuffer-index] [hits]
```

For example, the following command permits UDP packets sent from IP address 192.168.1.7 to IP address 192.168.1.8, with any UDP destination port less than 65,535. It puts this ACE first in the ACL, and counts the number of hits generated by the ACE.

```
WX1200# set security acl ip acl-5 permit udp
192.168.1.7 0.0.0.0 192.168.1.8 0.0.0.0 lt 65535
precedence 7 tos 15 before 1 hits
```

(For information about TOS and precedence levels, see the *Wireless LAN Switch and Controller Command Reference*. For CoS details, see "Class of Service" on page 382.)

Determining the ACE Order

The **set security acl** command creates a new entry in the edit buffer and appends the new entry as a rule at the end of an ACL, unless you specify otherwise. The order of ACEs is significant, because the earliest ACE takes precedence over later ACEs. To place the ACEs in the correct order, use the parameters **before** *editbuffer-index* and **modify** *editbuffer-index*. The first ACE is number 1.

To specify the order of the commands, use the following parameters:

- **before** *editbuffer-index* inserts an ACE before a specific location.
- **modify** *editbuffer-index* changes an existing ACE.

If the security ACL you specify when creating an ACE does not exist when you enter **set security acl ip**, the specified ACL is created in the edit buffer. If the ACL exists but is not in the edit buffer, the ACL reverts, or is rolled back, to the state when its last ACE was committed, but it now includes the new ACE.

For details, see "Placing One ACE before Another" on page 395 and "Modifying an Existing Security ACL" on page 396.

Committing a Security ACL

To put the security ACLs you have created into effect, use the **commit security acl** command with the name of the ACL. For example, to commit *acl-99*, type the following command:

```
WX1200# commit security acl acl-99
success: change accepted.
```

To commit all the security ACLs in the edit buffer, type the following command:

```
WX1200# commit security acl all
success: change accepted.
```

Viewing Security ACL Information

To determine whether a security ACL is committed, you can check the edit buffer and the committed ACLs. After you commit an ACL, MSS removes it from the edit buffer.

To display ACLs, use the following commands:

```
display security acl editbuffer
display security acl info all editbuffer
display security acl info
display security acl
```

Use the first two commands to display the ACLs that you have not yet committed to nonvolatile storage. The first command lists the ACLs by name. The second command shows the ACLs in detail.

Use the **display security acl info** command to display ACLs that are already committed. ACLs are not available for mapping until you commit them. (To commit an ACL, use the **commit security acl** command. See "Committing a Security ACL".)

ACLs do not take effect until you map them to something (a user, Distributed MAP, VLAN, port, or virtual port). To map an ACL, see "Mapping Security ACLs" on page 390. To display the mapped ACLs, use the **display security acl** command, without the **editbuffer** or **info** option.

Viewing the Edit Buffer

The edit buffer enables you to view the security ACLs you create before committing them to the configuration. To view a summary of the ACLs in the edit buffer, type the following command:

```
WX1200# display security acl editbuffer
ACL edit-buffer table
ACL                              Type Status
-------------------------------- ---- -------------
acl-99                           IP   Not committed
acl-blue                         IP   Not committed
acl-violet                       IP   Not committed
```

Viewing Committed Security ACLs

To view a summary of the committed security ACLs in the configuration, type the following command:

```
WX1200# display security acl
ACL table
ACL                              Type Class  Mapping
-------------------------------- ---- ------ -------
acl-2                            IP   Static
acl-3                            IP   Static
acl-4                            IP   Static
```

Viewing Security ACL Details

You can display the contents of one or all security ACLs that are committed. To display the contents of all committed security ACLs, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-999 (hits #2 0)
----------------------------------------------------
 1. deny IP source IP 192.168.0.1 0.0.0.0 destination IP any
 2. permit IP source IP 192.168.0.2 0.0.0.0 destination IP any enable-hits
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

You can also view a specific security ACL. For example, to view *acl-2*, type the following command:

```
WX1200# display security acl info acl-2
ACL information for acl-2
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP 
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

Displaying Security ACL Hits

Once you map an ACL, you can view the number of packets it has filtered, if you included the keyword **hits**. (For information on setting hits, see "Setting a Source IP ACL" on page 380.) Type the following command:

```
WX1200# display security acl hits
ACL hit-counters
Index Counter              ACL-name
----- -------------------- --------
    1                    0 acl-2
    2                    0 acl-999
    5                  916 acl-123
```

To sample the number of hits the security ACLs generate, you must specify the number of seconds between samples. For example, to sample the hits generated every 180 seconds, type the following commands:

```
WX1200# set security acl hit-sample-rate 180
WX1200# display security acl hits
ACL hit-counters
Index Counter              ACL-name
----- -------------------- --------
    1                31986 acl-red
    2                    0 acl-green
```

To display the security ACL hits on MAP 7, type the following command:

```
WX# display ap acl hits 7
ACL hit-counters for AP 7
Index Counter              ACL-name
----- -------------------- --------
    1                    0 acl_2
    2                    0 acl_175
    3                  916 acl_123
```

Clearing Security ACLs

The **clear security acl** command removes the ACL from the edit buffer only. To clear a security ACL, enter a specific ACL name, or enter **all** to delete all security ACLs. To remove the security ACL from the running configuration and nonvolatile storage, you must also use the **commit security acl** command.

For example, the following command deletes *acl-99* from the edit buffer:

```
WX1200# clear security acl acl-99
```

To clear *acl-99* from the configuration, type the following command:

```
WX1200# commit security acl acl-99
success: change accepted
```

Mapping Security ACLs

An ACL does not take effect until you commit it and map it to a user or an interface.

User-based security ACLs are mapped to an IEEE 802.1X authenticated session during the AAA process. You can specify that one of the authorization attributes returned during authentication is a named security ACL. The WX switch maps the named ACL automatically to the user's authenticated session.

Security ACLs can also be mapped statically to ports, VLANs, virtual ports, or Distributed MAPs. User-based ACLs are processed before these ACLs, because they are more specific and closer to the network edge.

Mapping User-Based Security ACLs

When you configure administrator or user authentication, you can set a Filter-Id authorization attribute at the RADIUS server or at the WX switch's local database. The Filter-Id attribute is a security ACL name (or two ACL names) with the direction of the packets indicated. The security ACL mapped by Filter-Id instructs the WX switch to use its local definition of the ACL, including the flow direction, to filter packets for the authenticated user.

The Filter-Id attribute is more often received by the WX through an external AAA RADIUS server than applied through the local database.

To map a security ACL to a user session, follow these steps:

1. Create the security ACL. For example, to filter packets coming from 192.168.253.1 and going to 192.168.253.12, type the following:

```
WX1200# set security acl ip acl-222 permit
ip 192.168.253.1 0.0.0.0 198.168.253.12 0.0.0.0
hits
```

2. Commit the security ACL to the running configuration. For example, to commit *acl-222*, type the following command:

```
WX1200# commit security acl acl-222
success: change accepted.
```

3. Apply the Filter-Id authentication attribute to a user's session via an external RADIUS server. For instructions, see the documentation for your RADIUS server.

If the Filter-Id value returned through the authentication and authorization process does not match the name of a committed security ACL in the WX, the user fails authorization and cannot be authenticated.

4. Alternatively, authenticate the user with the Filter-Id attribute in the WX switch's local database. Use one of the commands shown in Table 33. Specify **.in** for incoming packets or **.out** for outgoing packets.

Table 33 Mapping Commands

Mapping Target	Commands
User authenticated by a password	**set user** *username* **attr filter-id** *acl-name*.**in** **set user** *username* **attr filter-id** *acl-name*.**out**
User authenticated by a MAC address	**set mac-user** *username* **attr filter-id** *acl-name*.**in** **set mac-user** *username* **attr filter-id** *acl-name*.**out**

When assigned the Filter-Id attribute, an authenticated user with a current session receives packets based on the security ACL. For example, to restrict incoming packets for Natasha to those specified in *acl-222*, type the following command:

```
WX1200# set user Natasha attr filter-id acl-222.in
success: change accepted.
```

You can also map a security ACL to a user group. For details, see "Assigning a Security ACL to a User or a Group" on page 494. For more information about authenticating and authorizing users, see "About Administrative Access" on page 54 and "AAA Tools for Network Users" on page 441.

Mapping Security ACLs to Ports, VLANs, Virtual Ports, or Distributed MAPs

Security ACLs can be mapped to ports, VLANs, virtual ports, and Distributed MAPs. Use the following command:

```
set security acl map acl-name {vlan vlan-id | port port-list
[tag tag-value] | ap apnumber} {in | out}
```

Specify the name of the ACL, the port, VLAN, tag value(s) of the virtual port, or the number of the Distributed MAP to which the ACL is to be mapped, and the direction for packet filtering. For virtual ports or Distributed MAPs, you can specify a single value, a comma-separated list of values, a hyphen-separated range, or any combination, with no spaces. For example, to map security ACL *acl-222* to virtual ports 1 through 3 and 5 on port 2 to filter incoming packets, type the following command:

```
WX1200# set security acl map acl-222 port 2 tag 1-3,5 in
success: change accepted.
```

Plan your security ACL maps to ports, VLANs, virtual ports, and Distributed MAPs so that only one security ACL filters a flow of packets. If more than one security ACL filters the same traffic, you cannot guarantee the order in which the ACE rules are applied.

Displaying ACL Maps to Ports, VLANs, and Virtual Ports

Two commands display the port, VLAN, virtual port, and Distributed MAP mapping of a specific security ACL. For example, to show the ports, VLANs, virtual ports, and Distributed MAPs mapped to *acl-999*, type one of the following commands:

```
WX1200# display security acl map acl-999
ACL acl-999 is mapped to:
Port 9 In
Port 9 Out
WX1200# display security acl
ACL table
ACL                                Type Class  Mapping
---------------------------------- ---- ------ -------
acl-orange                         IP   Static
acl-999                            IP   Static Port 6 In
                                               Port 6 Out
acl-blue                           IP   Static Port 1 In
acl-violet                         IP   Static VLAN 1 Out
```

To display a summary of the security ACLs mapped on a MAP (in this example, MAP 7), type the following command:

```
WX# display ap acl map 7
ACL                          Type Class  Mapping
---------------------------- ---- ------ -------
acl_123                      IP   Static In
acl_133                      IP   Static In
acl_124                      IP   Static
```

Clearing a Security ACL Map

To clear the mapping between a security ACL and one or more ports, VLANs, virtual ports, or Distributed MAPS, first display the mapping with **display security acl map** and then use **clear security acl map** to remove it. This command removes the mapping, but not the ACL.

For example, to clear the security ACL *acljoe* from a port, type the following commands:

```
WX1200# display security acl map acljoe
ACL acljoe is mapped to:
Port 4 In
WX1200# clear security acl map acljoe port 4 in
success: change accepted.
```

After you clear the mapping between port 4 and ACL *acljoe*, the following is displayed when you enter **display security acl map**:

```
WX1200# display security acl map acljoe
ACL acljoe is mapped to:
```

Clearing a security ACL mapping does not stop the current filtering function if the ACL has other mappings. If the security ACL is mapped to another port, a VLAN, a virtual port, or a Distributed MAP, you must enter a **clear security acl map** command to clear each map.

To stop the packet filtering of a user-based security ACL, you must modify the user's configuration in the local database on the WX switch or on the RADIUS servers where packet filters are authorized. For information about deleting a security ACL from a user's configuration in the local WX database, see "Clearing a Security ACL from a User or Group" on page 495. To delete a security ACL from a user's configuration on a RADIUS server, see the documentation for your RADIUS server.

If you no longer need the security ACL, delete it from the configuration with the **clear security acl** and **commit security acl** commands. (See "Clearing Security ACLs" on page 390.)

Modifying a Security ACL

You can modify a security ACL in the following ways:

- Add another ACE to a security ACL, at the end of the ACE list. (See "Adding Another ACE to a Security ACL" on page 394.)
- Place an ACE before another ACE, so it is processed before subsequent ACEs, using the **before** *editbuffer-index* portion of the **set security acl** commands. (See "Placing One ACE before Another" on page 395.)
- Modify an existing ACE using the **modify** *editbuffer-index* portion of the **set security acl** commands. (See "Modifying an Existing Security ACL" on page 396.)
- Use the **rollback** command set to clear changes made to the security ACL edit buffer since the last time it was saved. The ACL is rolled back to its state at the last **commit** command. (See "Clearing Security ACLs from the Edit Buffer" on page 397.)
- Use the **clear security acl map** command to stop the filtering action of an ACL on a port, VLAN, or virtual port. (See "Clearing a Security ACL Map" on page 393.)
- Use **clear security acl** plus **commit security acl** to completely delete the ACL from the WX switch's configuration. (See "Clearing Security ACLs" on page 390.)

Adding Another ACE to a Security ACL

The simplest way to modify a security ACL is to add another ACE. For example, suppose you wanted to modify an existing ACL named *acl-violet.* Follow these steps:

1 To display all committed security ACLs, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-violet (hits #2 0)
----------------------------------------------------
 1. permit IP source IP 192.168.253.1 0.0.0.255 destination IP any enable-hits
```

2 To add another ACE to the end of *acl-violet*, type the following command:

```
WX1200# set security acl ip acl-violet permit
192.168.123.11 0.0.0.255 hits
```

3 To commit the updated security ACL *acl-violet*, type the following command:

```
WX1200# commit security acl acl-violet
success: change accepted.
```

4 To display the updated *acl-violet*, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-violet (hits #2 0)
----------------------------------------------------
 1. permit IP source IP 192.168.253.1 0.0.0.255 destination IP any enable-hits
 2. permit IP source IP 192.168.123.11 0.0.0.255 destination IP any enable-hits
```

Placing One ACE before Another

You can use the **before** *editbuffer-index* portion of the **set security acl** command to place a new ACE before an existing ACE. For example, suppose you want to deny some traffic from IP address 192.168.254.12 in *acl-111*. Follow these steps:

1 To display all committed security ACLs, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-111 (hits #4 0)
----------------------------------------------------
 1. permit IP source IP 192.168.253.11 0.0.0.0 destination IP any
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

2 To add the deny ACE to *acl-111* and place it first, type the following commands:

```
WX1200# set security acl ip acl-111 deny 192.168.254.12
0.0.0.255 before 1
WX1200# commit security acl acl-111
success: change accepted.
```

3 To view the results, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-111 (hits #4 0)
----------------------------------------------------
 1. deny IP source IP 192.168.254.12 0.0.0.255 destination IP any
 2. permit IP source IP 192.168.253.11 0.0.0.0 destination IP any
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

Modifying an Existing Security ACL

You can use the **modify** *editbuffer-index* portion of the **set security acl** command to modify an active security ACL. For example, suppose the ACL *acl-111* currently blocks some packets from IP address 192.168.254.12 with the mask 0.0.0.255 and you want to change the ACL to permit all packets from this address. Follow these steps:

1 To display all committed security ACLs, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-111 (hits #4 0)
----------------------------------------------------
 1. deny IP source IP 192.168.254.12 0.0.0.255 destination IP any
 2. permit IP source IP 192.168.253.11 0.0.0.0 destination IP any
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

2 To modify the first ACE in *acl-111*, type the following commands:

```
WX1200# set security acl ip acl-111 permit 192.168.254.12 0.0.0.0 modify 1
WX1200# commit security acl acl-111
success: change accepted.
```

3 To view the results, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-111 (hits #4 0)
----------------------------------------------------
 1. permit IP source IP 192.168.254.12 0.0.0.0 destination IP any
 2. permit IP source IP 192.168.253.11 0.0.0.0 destination IP any
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

Clearing Security ACLs from the Edit Buffer

Use the **rollback** command to clear changes made to the security ACL edit buffer since it was last committed. The ACL is rolled back to its state at the last **commit** command. For example, suppose you want to remove an ACE that you just created in the edit buffer for *acl-111*:

1 To display the contents of all committed security ACLs, type the following command:

```
WX1200# display security acl info
ACL information for all
set security acl ip acl-111 (hits #4 0)
----------------------------------------------------
 1. permit IP source IP 192.168.254.12 0.0.0.0 destination IP any
 2. permit IP source IP 192.168.253.11 0.0.0.0 destination IP any
set security acl ip acl-2 (hits #1 0)
----------------------------------------------------
 1. permit L4 Protocol 115 source IP 192.168.1.11 0.0.0.0 destination IP
192.168.1.15 0.0.0.0 precedence 0 tos 0 enable-hits
```

2 To view a summary of the security ACLs for which you just created ACEs in the edit buffer, type the following command:

```
WX1200# display security acl editbuffer
ACL edit-buffer table
ACL                             Type Status
------------------------------- ---- --------------
acl-a                           IP   Not committed
acl-111                         IP   Not committed
```

3 To view details about these uncommitted ACEs, type the following command.

```
WX1200# display security acl info all editbuffer
ACL edit-buffer information for all
set security acl ip acl-111 (ACEs 3, add 3, del 0, modified 2)
----------------------------------------------------
 1. permit IP source IP 192.168.254.12 0.0.0.0 destination IP any
 2. permit IP source IP 192.168.253.11 0.0.0.0 destination IP any
 3. deny SRC source IP 192.168.253.1 0.0.0.255
set security acl ip acl-a (ACEs 1, add 1, del 0, modified 0)
----------------------------------------------------
 1. permit SRC source IP 192.168.1.1 0.0.0.0
```

4 To clear the uncommitted *acl-111* ACE from the edit buffer, type the following command:

```
WX1200# rollback security acl acl-111
```

5 To ensure that you have cleared the *acl-111* ACE, type the following command. Only the uncommitted *acl-a* now appears.

```
WX1200# display security acl info all editbuffer
ACL edit-buffer information for all
set security acl ip acl-a (ACEs 1, add 1, del 0, modified 0)
----------------------------------------------------
 1. permit SRC source IP 192.168.1.1 0.0.0.0
```

6 Alternatively, to clear the entire edit buffer of all changes made since a security ACL was last committed and display the results, type the following commands:

```
WX1200# rollback security acl all
WX1200# display security acl info all editbuffer
ACL edit-buffer information for all
```

Using ACLs to Change CoS

For WMM or non-WMM traffic, you can change a packet's priority by using an ACL to change the packet's CoS value. A CoS value assigned by an ACE overrides the CoS value assigned by the switch's QoS map.

To change CoS values using an ACL, you must map the ACL to the outbound traffic direction on a MAP port, Distributed MAP, or user VLAN.

For example, to remap IP packets from IP address 10.10.20.5 that have IP precedence value 3, to have CoS value 7 when they are forwarded to any 10.10.30.x address on Distributed MAP 2, enter the following commands:

```
WX1200# set security acl ip acl1 permit cos 7 ip 10.10.20.5
0.0.0.0 10.10.30.0 0.0.0.255 precedence 3
success: change accepted.
QX1200# set security acl ip acl1 permit any
success: change accepted.
WX1200# commit security acl acl1
success: change accepted.
WX1200# set security acl map acl1 ap 2 out
success: change accepted.
```

The default action on an interface and traffic direction that has at least one access control entry (ACE) configured, is to deny all traffic that does not match an ACE on that interface and traffic direction. The **permit any** ACE ensures that traffic that does not match the first ACE is permitted. Without this additional ACE at the end, traffic that does not match the other ACE is dropped.

Filtering Based on DSCP Values

You can configure an ACE to filter based on a packet's Differentiated Services Code Point (DSCP) value, and change the packet's CoS based on the DSCP value. A CoS setting marked by an ACE overrides the CoS setting applied from the switch's QoS map.

Table 34 lists the CoS values to use when reassigning traffic to a different priority. The CoS determines the MAP forwarding queue to use for the traffic when sending it to a wireless client.

Table 34 Class-of-Service (CoS) Packet Handling

WMM Priority Desired	CLI CoS Value to Enter
Background	**1** or **2**
Best effort	**0** or **3**
Video	**4** or **5**
Voice	**6** or **7**

Using the dscp Option

The easiest way to filter based on DSCP is to use the **dscp** *codepoint* option. The following commands remap IP packets from IP address 10.10.50.2 that have DSCP value 46 to have CoS value 7 when they are forwarded to any 10.10.90.x address on Distributed MAP 4:

```
WX1200# set security acl ip acl2 permit cos 7 ip 10.10.50.2
0.0.0.0 10.10.90.0 0.0.0.255 dscp 46
success: change accepted.
WX1200# set security acl ip acl2 permit any
success: change accepted.
WX1200# commit security acl acl2
success: change accepted.
WX1200# set security acl map acl2 ap 4 out
success: change accepted.
```

Using the precedence and tos Options

You also can indirectly filter on DSCP by filtering on both the IP precedence and IP ToS values of a packet. However, this method requires two ACEs. To use this method, specify the combination of precedence and ToS values that is equivalent to the DSCP value. For example, to filter based on DSCP value 46, configure an ACL that filters based on precedence 5 and ToS 12. (To display a table of the precedence and ToS combinations for each DSCP value, use the **display qos dscp-table** command.)

The following commands perform the same CoS reassignment as the commands in "Using the dscp Option" on page 400. They remap IP packets from IP address 10.10.50.2 that have DSCP value 46 (equivalent to precedence value 5 and ToS value 12), to have CoS value 7 when they are forwarded to any 10.10.90.x address on Distributed MAP 4:

```
WX1200# set security acl ip acl2 permit cos 7 ip 10.10.50.2
0.0.0.0 10.10.90.0 0.0.0.255 precedence 5 tos 12
success: change accepted.
WX1200# set security acl ip acl2 permit cos 7 ip 10.10.50.2
0.0.0.0 10.10.90.0 0.0.0.255 precedence 5 tos 13
success: change accepted.
WX1200# set security acl ip acl2 permit any
success: change accepted.
WX1200# commit security acl acl2
success: change accepted.
WX1200# set security acl map acl2 ap 4 out
success: change accepted.
```

The ACL contains two ACEs. The first ACE matches on precedence 5 and ToS 12. The second ACE matches on precedence 5 and ToS 13. The IP precedence and ToS fields use 7 bits, while the DSCP field uses only 6 bits. Following the DSCP field is a 2-bit ECN field that can be set by other devices based on network congestion. The second ACE is required to ensure that the ACL matches regardless of the value of the seventh bit.

You cannot use the ***dscp*** *option along with the precedence and tos options in the same ACE. The CLI rejects an ACE that has this combination of options.*

Enabling Prioritization for Legacy Voice over IP

MSS supports Wi-Fi Multimedia (WMM). WMM support is enabled by default and is automatically used for priority traffic between WMM-capable devices.

MSS also can provide prioritization for non-WMM VoIP devices. However, to provide priority service to non-WMM VoIP traffic, you must configure static CoS or configure an ACL to set the CoS for the traffic. The MAP maps the CoS value assigned by static CoS or the ACL to a forwarding queue. The examples in this section show how to configure CoS using ACLs. To use static CoS instead, see "Configuring Static CoS" on page 343.

General Guidelines

3Com recommends that you follow these guidelines for any wireless VoIP implementation:

- Ensure end-to-end priority forwarding by making sure none of the devices that will forward voice traffic resets IP ToS or Diffserv values to 0. Some devices, such as some types of Layer 2 switches with basic Layer 3 awareness, reset the IP ToS or Diffserv value of *untrusted* packets to 0.

  MSS uses IP ToS values to prioritize voice traffic. For example, when a MAP receives traffic from its WX switch, the MAP classifies the traffic based on the IP ToS value in the IP header of the tunnel that is carrying the traffic. By default, the WX switch marks egress traffic for priority forwarding only if WMM is enabled and only if the ingress traffic was marked for priority forwarding. If another forwarding device in the network resets a voice packet's priority by changing the IP ToS or Diffserv value to 0, the WX does not reclassify the packet, and the packet does not receive priority forwarding on the MAP.
- For WMM-capable devices, leave WMM enabled.
- For SVP devices, change the QoS mode to svp. You also need to disable IGMP snooping, and configure an ACL that marks egress traffic from the voice VLAN with CoS value 7. (See "Enabling SVP Optimization for SpectraLink Phones" on page 404 for complete configuration guidelines.)

  For other types of non-WMM devices, you do not need to change the QoS mode, but you must configure an ACL to mark the traffic's CoS value. This section shows examples for configuring VoIP for devices that use TeleSym.

Table 35 shows how WMM priority information is mapped across the network. When WMM is enabled in MSS, WX switches and MAPs perform these mappings automatically.

Table 35 WMM Priority Mappings

Service Type	IP Precedence	IP ToS	DSCP	802.1p	CoS	MAP Forwarding Queue
0	0	0	0	0	0	Background
3	3	0x60	24	3	3	
1	1	0x20	8	1	1	Best Effort
2	2	0x40	16	2	2	
4	4	0x80	32	4	4	Video
5	5	0xa0	40	5	5	
6	6	0xc0	48	6	6	Voice
7	7	0xe0	56	7	7	

If you are upgrading a switch running MSS Version 3.x to MSS Version 4.x, and the switch uses ACLs to map VoIP traffic to CoS 4 or 5, and you plan to leave WMM enabled, 3Com recommends that you change the ACLs to map the traffic to CoS 6 or 7.

You must map the ACL to the outbound traffic direction on a MAP port, Distributed MAP, or user VLAN. An ACL can set a packet's CoS only in these cases.

You can enable legacy VoIP support on a VLAN, port group, port list, virtual port list, Distributed MAP, or user glob. You do not need to disable WMM support.

Enabling VoIP Support for TeleSym VoIP

To enable VoIP support for TeleSym packets, which use UDP port 3344, for all users in VLAN *corp_vlan*, perform the following steps:

1 Configure an ACE in ACL *voip* that assigns IP traffic from any IP address with source UDP port 3344, addressed to any destination address, to CoS queue 6:

```
WX4400# set security acl ip voip permit cos 6 udp any eq 3344
any
```

2 Configure another ACE to change the default action of the ACL from deny to permit. Otherwise, the ACL permits only voice traffic that matches the previous ACE and denies all other traffic.

```
WX4400# set security acl ip voip permit any
```

3 Commit the ACL to the configuration:

```
WX4400# commit security acl voip
```

Enabling SVP Optimization for SpectraLink Phones

SpectraLink's Voice Interoperability for Enterprise Wireless (VIEW) Certification Program is designed to ensure interoperability and high performance between SVP phones and WLAN infrastructure products. This section describes how to configure WXs and MAPs for SVP phones.

3Com recommends that you plan for a maximum of 6 wireless phones per MAP.

To configure MSS for SVP phones, perform the following configuration tasks:

- Install MAPs and configure them on the switch. (The examples in this section assume this is already done.)
- Configure a service for the voice SSID. The service profile also specifies the encryption parameters to use for the SSID. This section shows configuration examples for WPA and for RSN (WPA2).
- Configure a radio profile to manage the radios that will provide service for the voice SSID.
- Configure a VLAN for the voice clients.
- Configure a last-resort user in the local database.
- Configure an authentication and accounting rule that allows clients of the voice SSID onto the network and places them in the voice VLAN.
- Configure an ACL that marks ingress and egress traffic to and from the voice VLAN with CoS value 7.

Known Limitations

- You cannot have WPA and WPA2 configured on handsets simultaneously within the same ESSID. SVP phones will not check-in.
- You must disable IGMP snooping when running SpectraLink's SRP protocol. SRP uses multicast packets to check-in which are not forwarded through the WX when IGMP snooping is enabled. When a tunneled VLAN is configured over a Layer 3 network, IGMP snooping must be disabled each time the tunnel is established, because the virtual VLAN is established with IGMP snooping turned on by default.

Configuring a Service Profile for RSN (WPA2)

To configure a service profile for SVP phones that use RSN (WPA2):

- Create the service profile and add the voice SSID to it.
- Enable the RSN information element (IE).
- Disable TKIP and enable CCMP.
- Disable 802.1X authentication and enable preshared key (PSK) authentication instead.
- Enter the PSK key.
- Set the service profile’s VLAN attribute to the name of the VLAN you create for the voice clients.

The following commands configure a service profile called *vowlan-wpa2* for RSN:

```
WX4400# set service-profile vowlan-wpa2 ssid-name phones
WX4400# set service-profile vowlan-wpa2 rsn-ie enable
WX4400# set service-profile vowlan-wpa2 cipher-tkip disable
WX4400# set service-profile vowlan-wpa2 cipher-ccmp enable
WX4400# set service-profile vowlan-wpa2 auth-dot1x disable
WX4400# set service-profile vowlan-wpa2 auth-psk enable
WX4400# set service-profile vowlan-wpa2 psk-raw
  c25d3fe4483e867d1df96eaacdf8b02451fa0836162e758100f5f6b879
65e59d
WX4400# set service-profile vowlan-wpa2 attr vlan-name v1
```

Configuring a Service Profile for WPA

To configure a service profile for SVP phones that use WPA:

- Create the service profile and add the voice SSID to it.
- Enable the WPA information element (IE). This also enables TKIP. Leave TKIP enabled.
- Disable 802.1X authentication and enable preshared key (PSK) authentication instead.
- Enter the PSK key.
- Set the service profile’s VLAN attribute to the name of the VLAN you create for the voice clients.

The following commands configure a service profile called *vowlan-wpa2* for RSN:

```
WX4400# set service-profile vowlan-wpa ssid-name phones
WX4400# set service-profile vowlan-wpa wpa-ie enable
WX4400# set service-profile vowlan-wpa auth-dot1x disable
WX4400# set service-profile vowlan-wpa auth-psk enable
WX4400# set service-profile vowlan-wpa psk-raw
  c25d3fe4483e867d1df96eaacdf8b02451fa0836162e758100f5f6b879
65e59d
WX4400# set service-profile vowlan-wpa attr vlan-name v1
```

Configuring a Radio Profile

MSS has a default radio profile, which manages all radios by default. Some of the radio parameters require changes for voice traffic. You can modify the default radio profile or create a new one.

Some radio settings that are beneficial for voice traffic might not be beneficial for other wireless clients. If you plan to support other wireless clients in addition to voice clients, 3Com recommends that you create a new radio profile specifically for voice clients, or use the default radio profile only for voice clients and create a new profile for other clients. The examples in this section modify the default radio profile for voice clients.

To create or modify a radio profile for voice clients:

- Map the service profile you created for the voice SSID to the radio profile.
- Change the delivery traffic indication map (DTIM) interval to 3.
- Change the QoS mode to SVP. (This also disables WMM.)
- Configure MAPs, if not already configured.
- Map radios to the radio profile and enable them.

The following commands modify the default radio profile for SVP phones:

```
WX1200# set radio-profile default service-profile vowlan-wpa2
WX1200# set radio-profile default dtim-interval 3
WX1200# set radio-profile default qos-mode svp
```

The MAP radios are already in the default radio profile by default, so they do not need to be explicitly added to the profile. However, if you create a new radio profile for voice clients, you will need to disable the radios, map them to the new radio profile, then reenable them.

Configuring a VLAN for Voice Clients

MSS requires all clients to be authenticated by RADIUS or the local database, and to be authorized for a specific VLAN. MSS places the user in the authorized VLAN.

- Configure a VLAN for voice clients

You can use the same VLAN for other clients. However, it is a best practice to use the VLAN primarily, if not exclusively, for voice traffic.

- Disable IGMP snooping in the VLAN. (Disabling this feature is required for SVP.)

To configure a VLAN and a last-resort user for the voice SSID:

```
WX4400# set vlan 2 name v1 port 3
WX4400# set igmp disable vlan v1
```

The **set vlan** and **set igmp** commands create VLAN *v1* and add the uplink port to it, then disable IGMP snooping in the VLAN.

Configuring an ACL to Prioritize Voice Traffic

MSS does not provide priority forwarding for SVP traffic by default. To enable prioritization for SVP traffic, you must configure an ACL and map it to the both the inbound and outbound directions of the VLAN to which the voice clients are assigned. The ACL must contain an ACE that matches on IP protocol 119 and marks the IP ToS bits in matching packets with CoS value 7. When a MAP receives a packet with CoS value 7, the MAP places the packet in the voice queue for priority forwarding.

If the VLAN will be shared by other clients, you also need to add an ACE that permits the traffic that is not using IP protocol 119. Otherwise, the WX drops this traffic. Every ACL has an implicit ACE at the end that denies all traffic that does not match any of the other ACEs in the ACL.

After you configure the ACE and map it to the VLAN, you must commit the VLAN to the configuration. The ACL does not take effect until you map it and commit it.

The following commands configure an ACE to prioritize SVP traffic and map the ACE to the outbound direction of the voice VLAN:

```
WX1200# set security acl ip SVP permit cos 7 udp 10.2.4.69
255.255.255.255 gt 0 any gt 0
```

```
WX1200# set security acl ip SVP permit cos 7 119 0.0.0.0
255.255.255.255 0.0.0.0 255.255.255.255
WX1200# set security acl ip SVP permit 0.0.0.0
255.255.255.255
WX1200# set security acl map SVP vlan v1 in
WX1200# set security acl map SVP vlan v1 out
WX1200# commit security acl SVP
```

The first ACE is needed only if the active-scan feature is enabled in the radio profile. The ACE ensures that active-scan reduces its off-channel time in the presence of FTP traffic from the TFTP server, by setting the CoS of the server traffic to 7. This ACE gives CoS 7 to UDP traffic from TFTP server 10.2.4.69 to any IP address, to or from any UDP port other than 0. (For more information, see "RF Detection Scans" on page 571.)

The second ACE sets CoS to 7 for all SVP traffic.

The third ACE matches on all traffic that does not match on either of the previous ACEs.

Reason the ACL Needs To Be Mapped to Both Traffic Directions If the ACL is not also mapped to the inbound direction on the voice VLAN, CoS will not be marked in the traffic if the path to the SVP handset is over a tunnel. MSS does not support mapping an ACL to a tunneled VLAN.

When configured in a Mobility Domain, WX switches dynamically create tunnels to bridge clients to non-local VLANs. A non-local VLAN is a VLAN that is not configured on the WX that is forwarding the client's traffic. MSS does not support mapping an ACL to a non-local VLAN. The CLI accepts the configuration command but the command is not saved in the configuration.

Consider switch-1 with VLAN_A and switch-2 with VLAN_B. If a handset connected to switch-2 is placed in VLAN_A, a tunnel is created between switch-1 and switch-2. If an ACL is mapped to VLAN_A-out on switch-1, it will affect local clients but not clients using the same VLAN on switch-2. Also, if an ACL is mapped to VLAN_A-in on switch-1, it will affect remote clients on switch-2, but not local clients. 3Com recommends mapping ACLs both vlan-in and vlan-out to ensure proper CoS marking in both directions.

Setting 802.11b/g Radios to 802.11b (for Siemens SpectraLink VoIP Phones only)

If you plan to use Siemens SpectraLink Voice over IP (VoIP) phones, you must change the MAP radios that will support the phones to operate in 802.11b mode only. This type of phone expects the MAP to operate at 802.11b rates only, not at 802.11g rates. To change a radio to support 802.11b mode only, use the **radiotype 11b** option with the **set ap** command.

Disabling RF Auto-Tuning Before Upgrading a SpectraLink Phone

If you plan to upgrade a SpectraLink phone using TFTP over a MAP, 3Com recommends that you disable RF Auto-Tuning before you begin the upgrade. This feature can increase the length of time required for the upgrade. You can disable RF Auto-Tuning on a radio-profile basis. Use the following commands:

```
set radio-profile name auto-tune channel-config disable
set radio-profile name auto-tune power-config disable
```

Restricting Client-To-Client Forwarding Among IP-Only Clients

You can use an ACL to restrict clients in a VLAN from communicating directly at the IP layer. Configure an ACL that has ACEs to permit traffic to and from the router (gateway), an ACE that denies traffic between all other addresses within the subnets, and another ACE that allows traffic that doesn't match the other ACEs.

AN ACL can restrict IP forwarding but not Layer 2 forwarding. To restrict Layer 2 forwarding, see "Restricting Layer 2 Forwarding Among Clients" on page 94.

For example, to restrict client-to-client forwarding within subnet 10.10.11.0/24 in VLAN *vlan-1* with router 10.10.11.8, perform the following steps:

1. Configure an ACE that permits all traffic from the gateway IP address to any other IP address:

```
WX1200# set security acl ip c2c permit 10.10.11.8 0.0.0.0
```

2. Configure an ACE that permits traffic from any IP address to the router IP address:

```
WX1200# set security acl ip c2c permit ip 0.0.0.0
255.255.255.255 10.10.11.8 0.0.0.0
```

3. Configure an ACE that denies all IP traffic from any IP address in the 10.10.11.0/24 subnet to any address in the same subnet.

```
WX1200# set security acl ip c2c deny ip 10.10.11.0 0.0.0.255
10.10.11.0 0.0.0.255
```

4. Configure an ACE that permits all traffic that does not match the ACEs configured above:

```
WX1200# set security acl ip c2c permit 0.0.0.0
255.255.255.255
```

5. Commit the ACL to the configuration:

```
WX1200# commit security acl c2c
```

6. Map the ACL to the outbound and inbound traffic directions of VLAN *vlan-1*:

```
WX1200# set security acl map c2c vlan vlan-1 out
WX1200# set security acl map c2c vlan vlan-1 in
```

The commands in steps 1 and 2 permit traffic to and from the router (gateway). If the subnet has more than one gateway, add a similar pair of ACEs for each default router. Add the default router ACEs before the ACEs that block all traffic to and from addresses within the subnet.

Security ACL Configuration Scenario

The following scenario illustrates how to create a security ACL named *acl-99* that consists of one ACE to permit incoming packets from one IP address, and how to map the ACL to a port and a user:

1. Type the following command to create and name a security ACL and add an ACE to it.

```
WX1200# set security acl ip acl-99 permit 192.168.1.1 0.0.0.0
```

2. To view the ACE you have entered, type the following command:

```
WX1200# display security acl editbuffer
ACL                                  Type Status
----------------------------------- ---- -------------
acl-99                               IP   Not committed
```

3. To save *acl-99* and its associated ACE to the configuration, type the following command:

```
WX1200# commit security acl acl-99
success: change accepted.
```

4 To map *acl-99* to port 6 to filter incoming packets, type the following command:

```
WX1200# set security acl map acl-99 port 6 in
mapping configuration accepted
```

Because every security ACL includes an implicit rule denying all traffic that is not permitted, port 6 now accepts packets only from 192.168.1.1, and denies all other packets.

5 To map *acl-99* to user Natasha's sessions when you are using the local WX database for authentication, configure Natasha in the database with the Filter-Id attribute. Type the following commands:

```
WX1200# set authentication dot1x Natasha local
success: change accepted.
WX1200# set user natasha attr filter-id acl-99.in
success: change accepted.
```

6 Alternatively, you can map *acl-99* to Natasha's sessions when you are using a remote RADIUS server for authentication. To configure Natasha for pass-through authentication to the RADIUS server *shorebirds*, type the following command:

```
WX1200# set authentication dot1x Natasha pass-through
shorebirds
success: change accepted.
```

You must then map the security ACL to Natasha's session in RADIUS. For instructions, see the documentation for your RADIUS server.

7 To save your configuration, type the following command:

```
WX1200# save config
success: configuration saved.
```

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MANAGING KEYS AND CERTIFICATES

A digital certificate is a form of electronic identification for computers. The WX switch requires digital certificates to authenticate its communications to 3Com Wireless Switch Manager and Web Manager, to WebAAA clients, and to Extensible Authentication Protocol (EAP) clients for which the WX performs all EAP processing. Certificates can be generated on the WX or obtained from a certificate authority (CA). Keys contained within the certificates allow the WX, its servers, and its wireless clients to exchange information secured by encryption.

If the switch does not already have certificates, MSS automatically generates the missing ones the first time you boot using MSS Version 4.2 or later. You do not need to install certificates unless you want to replace the ones automatically generated by MSS. (For more information, see "Certificates Automatically Generated by MSS" on page 418.)

Before installing a new certificate, verify with the ***display timedate*** *and* ***display timezone*** *commands that the WX switch is set to the correct date, time, and time zone. Otherwise, certificates might not be installed correctly.*

Why Use Keys and Certificates?

Certain WX switch operations require the use of public-private key pairs and digital certificates. All 3Com Wireless Switch Manager and Web Manager users, and users for which the WX performs IEEE 802.1X EAP authentication or WebAAA, require public-private key pairs and digital certificates to be installed on the WX switch.

These keys and certificates are fundamental to securing wireless, wired authentication, and administrative connections because they support Wi-Fi Protected Access (WPA) encryption and dynamic Wired-Equivalency Privacy (WEP) encryption.

Wireless Security through TLS

In the case of wireless or wired authentication 802.1X users whose authentication is performed by the WX switch, the first stage of any EAP transaction is Transport Layer Security (TLS) authentication and encryption. 3Com Wireless Switch Manager and Web Manager also require a session to the WX switch that is authenticated and encrypted by TLS. Once a TLS session is authenticated, it is encrypted.

TLS allows the client to authenticate the WX switch (and optionally allows the WX switch to authenticate the client) through the use of digital signatures. Digital signatures require a public-private key pair. The signature is created with a private key and verified with a public key. TLS enables secure key exchange.

PEAP-MS-CHAP-V2 Security

PEAP performs a TLS exchange for server authentication and allows a secondary authentication to be performed inside the resulting secure channel for client authentication. For example, the Microsoft Challenge Handshake Authentication Protocol version 2 (MS-CHAP-V2) performs mutual MS-CHAP-V2 authentication inside an encrypted TLS channel established by PEAP.

1. To form the encrypted TLS channel, the WX switch must have a digital certificate and must send that certificate to the wireless client.
2. Inside the WX switch's digital certificate is the WX switch's public key, which the wireless client uses to encrypt a pre-master secret key.
3. The wireless client then sends the key back to the WX switch so that both the WX and the client can derive a key from this pre-master secret for secure authentication and wireless session encryption.

Clients authenticated by PEAP need a certificate in the WX switch only when the switch performs PEAP locally, not when EAP processing takes place on a RADIUS server. (For details about authentication options, see Chapter 21, "Configuring AAA for Network Users," on page 433.)

About Keys and Certificates

Public-private key pairs and digital signatures and certificates allow keys to be generated dynamically so that data can be securely encrypted and delivered. You generate the key pairs and certificates on the WX switch or install them on the switch after enrolling with a certificate authority (CA). The WX switch can generate key pairs, self-signed certificates, and Certificate Signing Requests (CSRs), and can install key pairs, server certificates, and certificates generated by a CA.

The WX switch uses separate server certificates for Admin, EAP (802.1X), and WebAAA authentication. Where applicable, the manuals refer to these server certificates as Admin, EAP (or 802.1X), or WebAAA certificates respectively.

When the WX switch needs to communicate with 3Com Wireless Switch Manager, Web Manager, or an 802.1X or WebAAA client, MSS requests a private key from the switch's certificate and key store:

- If no private key is available in the WX switch's certificate and key store, the switch does not respond to the request from MSS. If the switch does have a private key in its key store, MSS requests a corresponding certificate.
- If the WX switch has a self-signed certificate in its certificate and key store, the switch responds to the request from MSS. If the certificate is not self-signed, the switch looks for a CA's certificate with which to validate the server certificate.
- If the WX switch has no corresponding CA certificate, the switch does not respond to the request from MSS. If the switch does have a corresponding CA certificate, and the server certificate is validated (date still valid, signature approved), the switch responds.

If the WX switch does not respond to the request from MSS, authentication fails and access is denied.

For EAP (802.1X) users, the public-private key pairs and digital certificates can be stored on a RADIUS server. In this case, the WX switch operates as a pass-through authenticator.

Public Key Infrastructures

A public-key infrastructure (PKI) is a system of digital certificates and certification authorities that verify and authenticate the validity of each party involved in a transaction through the use of public key cryptography. To have a PKI, the WX switch requires the following:

- A public key
- A private key
- Digital certificates
- A CA
- A secure place to store the private key

A PKI enables you to securely exchange and validate digital certificates between WX switches, servers, and users so that each device can authenticate itself to the others.

Public and Private Keys

3Com's identity-based networking uses public key cryptography to enforce the privacy of data transmitted over the network. Using public-private key pairs, users and devices can send encrypted messages that only the intended receiver can decrypt.

Before exchanging messages, each party in a transaction creates a key pair that includes the public and private keys. The public key encrypts data and verifies digital signatures, and the corresponding private key decrypts data and generates digital signatures. Public keys are freely exchanged as part of digital certificates. Private keys are stored securely.

Digital Certificates

Digital certificates bind the identity of network users and devices to a public key. Network users must authenticate their identity to those with whom they communicate, and must be able to verify the identity of other users and network devices, such as switches and RADIUS servers.

The 3Com Mobility System supports the following types of X.509 digital certificates:

- **Administrative certificate**—Used by the WX switch to authenticate itself to 3Com Wireless Switch Manager or Web Manager.
- **WX-WX security certificate**—Used by WX switches in a Mobility Domain to securely exchange management information. (For more information about this option, see "Configuring WX-WX Security" on page 158.

- **EAP certificate**—Used by the WX switch to authenticate itself to EAP clients.
- **WebAAA certificate**—Used by the WX switch to authenticate itself to WebAAA clients, who use a web page served by a WX switch to log onto the network.
- **Certificate authority (CA) certificates**—Used by the WX switch in addition to the certificates listed above, when those certificates are from the CA.

The Admin, EAP, and WebAAA certificates can be generated by the WX switch (self-signed) or generated and signed by a CA. If they are signed by a CA, the CA's own certificate is also required.

PKCS #7, PKCS #10, and PKCS #12 Object Files

Public-Key Cryptography Standards (PKCS) are encryption interface standards created by RSA Data Security, Inc., that provide a file format for transferring data and cryptographic information. 3Com supports the PKCS object files listed in Table 36.

Table 36 PKCS Object Files Supported by 3Com

File Type	Standard	Purpose
PKCS #7	Cryptographic Message Syntax Standard	Contains a digital certificate signed by a CA. To install the certificate from a PKCS #7 file, use the **crypto certificate** command to prepare MSS to receive the certificate, then copy and paste the certificate into the CLI. A PKCS #7 file does not contain the public key to go with the certificate. Before you generate the CSR and instal the certificate, you must generate the public-private key pair using the **crypto generate key** command.
PKCS #10	Certification Request Syntax Standard	Contains a Certificate Signing Request (CSR), a special file with encoded information needed to request a digital certificate from a CA. To generate the request, use the **crypto generate request** command. Copy and paste the results directly into a browser window on the CA server, or into a file to send to the CA server.

Table 36 PKCS Object Files Supported by 3Com (continued)

File Type	Standard	Purpose
PKCS #12	Personal Information Exchange Syntax Standard	Contains a certificate signed by a CA *and* a public-private key pair provided by the CA to go with the certificate. Because the key pair comes from the CA, you do not need to generate a key pair or a certificate request on the switch. Instead, use the **copy tftp** command to copy the file onto the WX switch. Use the **crypto otp** command to enter the one-time password assigned to the file by the CA. (This password secures the file so that the keys and certificate cannot be installed by an unauthorized party. You must know the password in order to install them.) Use the **crypto pkcs12** command to unpack the file.

Certificates Automatically Generated by MSS

The first time you boot a switch with MSS Version 4.2 or later, MSS automatically generates keys and self-signed certificates, in cases where certificates are not already configured or installed. MSS can automatically generate all the following types of certificates and their keys:

- Admin (required for administrative access to the switch by Web Manager or 3Com Wireless Switch Manager)
- EAP (required for 802.1X user access through the switch)
- Web (required for WebAAA user access through the switch)

The keys are 512 bytes long.

MSS automatically generates self-signed certificates *only* in cases where no certificate is already configured. MSS does not replace self-signed certificates or CA-signed certificates that are already configured on the switch. You can replace an automatically generated certificate by creating another self-signed one or by installing a CA-signed one. To use a longer key, configure the key before creating the new certificate (or certificate request, if you plan to install a CA-signed certificate).

If generated by MSS Version 4.2.3 or later, the automatically generated certificates are valid for three years, beginning one week before the time and date on the switch when the certificate is generated.

Creating Keys and Certificates

Public-private key pairs and digital certificates are required for management access with 3Com Wireless Switch Manager or Web Manager, or for network access by 802.1X or WebAAA users. The digital certificates can be self-signed or signed by a certificate authority (CA). If you use certificates signed by a CA, you must also install a certificate from the CA to validate the digital signatures of the certificates installed on the WX switch.

Generally, CA-generated certificates are valid for one year beginning with the system time and date that are in effect when you generate the certificate request. Self-signed certificates generated when running MSS Version 4.2.3 or later are valid for three years, beginning one week before the time and date on the switch when the certificate is generated.

Each of the following types of access requires a separate key pair and certificate:

- Admin—Administrative access through 3Com Wireless Switch Manager or Web Manager
- EAP—802.1X access for network users who can access SSIDs encrypted by WEP or WPA, and for users connected to wired authentication ports
- WebAAA—Web access for network users who can use a web page to log onto an unencrypted SSID

Management access to the CLI through Secure Shell (SSH) also requires a key pair, but does not use a certificate. (For more SSH information, see “Managing SSH” on page 113.)

WX-WX security also requires a key pair and certificate. However, the certificate is generated automatically when you enable WX-WX security.

Choosing the Appropriate Certificate Installation Method for Your Network

Depending on your network environment, you can use any of the following methods to install certificates and their public-private key pairs. The methods differ in terms of simplicity and security. The simplest method is also the least secure, while the most secure method is slightly more complex to use.

- **Self-signed certificate**—The easiest method to use because a CA server is not required. The WX switch generates and signs the certificate itself. This method is the simplest but is also the least secure, because the certificate is not validated (signed) by a CA.
- **PKCS #12 object file certificate**—More secure than using self-signed certificates, but slightly less secure than using a Certificate Signing Request (CSR), because the private key is distributed in a file from the CA instead of generated by the WX switch itself. The PKCS #12 object file is more complex to deal with than self-signed certificates. However, you can use 3Com Wireless Switch Manager, Web Manager, or the CLI to distribute this certificate. The other two methods can be performed only using the CLI.
- **Certificate Signing Request (CSR)**—The most secure method, because the WX switch's public and private keys are created on the WX switch itself, while the certificate comes from a trusted source (CA). This method requires generating the key pair, creating a CSR and sending it to the CA, cutting and pasting the certificate signed by the CA into the CLI, and then cutting and pasting the CA's own certificate into the CLI.

Table 37 lists the steps required for each method and refers you to appropriate instructions. (For complete examples, see "Key and Certificate Configuration Scenarios" on page 427.)

Table 37 Procedures for Creating and Validating Certificates

File Type	Steps Required	Instructions
Self-signed certificate	**1** Generate a public-private key pair on the WX switch. **2** Generate a self-signed certificate on the WX switch.	▪ "Creating Public-Private Key Pairs" on page 421 ▪ "Generating Self-Signed Certificates" on page 422

Table 37 Procedures for Creating and Validating Certificates (continued)

File Type	Steps Required	Instructions
PKCS #12 object file certificate	**1** Copy a PKCS #12 object file (public-private key pair, server certificate, and CA certificate) from a CA onto the WX switch. **2** Enter the one-time password to unlock the file. **3** Unpack the file into the switch's certificate and key store.	"Installing a Key Pair and Certificate from a PKCS #12 Object File" on page 423
Certificate Signing Request (CSR) certificate	**1** Generate a public-private key pair on the WX switch. **2** Generate a CSR on the switch as a PKCS #10 object file. **3** Give the CSR to a CA and receive a signed certificate (a PEM-encoded PKCS #7 object file). **4** Paste the PEM-encoded file into the CLI to store the certificate on the WX switch. **5** Obtain and install the CA's own certificate.	▪ "Creating Public-Private Key Pairs" on page 421 ▪ "Creating a CSR and Installing a Certificate from a PKCS #7 Object File" on page 424 ▪ "Installing a CA's Own Certificate" on page 425

Creating Public-Private Key Pairs

To use a self-signed certificate or Certificate Signing Request (CSR) certificate for WX switch authentication, you must generate a public-private key pair.

To create a public-private key pair, use the following command:

```
crypto generate key {admin | domain | eap | ssh | web}
{128 | 512 | 1024 | 2048}
```

Choose the key length based on your need for security or to conform with your organization's practices. For example, the following command generates an administrative key pair of 1024 bits:

You must paste the entire block, from the beginning -----BEGIN CERTIFICATE REQUEST----- to the end -----END CERTIFICATE REQUEST-----.

```
# crypto generate key admin 1024
admin key pair generated
```

Some key lengths apply only to specific key types. For example, **128** applies only to **domain** keys.

SSH requires an SSH authentication key, but you can allow MSS to generate it automatically. The first time an SSH client attempts to access the SSH server on a WX switch, the switch automatically generates a 1024-byte SSH key. If you want to use a 2048-byte key instead, use the **crypto generate key ssh 2048** command to generate one.

After you generate or install a certificate (described in the following sections), do not create the key pair again. If you do, the certificate might not work with the new key, in which case you will need to regenerate or reinstall the certificate.

Generating Self-Signed Certificates

After creating a public-private key pair, you can generate a self-signed certificate. To generate a self-signed certificate, use the following command:

```
crypto generate self-signed {admin | eap | web}
```

When you type the command, the CLI prompts you to enter information to identify the certificate. For example:

You must paste the entire block, from the beginning -----BEGIN CERTIFICATE REQUEST----- to the end -----END CERTIFICATE REQUEST-----.

```
# crypto generate self-signed admin
Country Name: US
State Name: CA
Locality Name: San Jose campus
Organizational Name: mycorp
Organizational Unit: eng
Common Name: WX1
Email Address: admin@example.com
Unstructured Name: WX in wiring closet 120
success: self-signed cert for admin generated
```

You *must* include a common name (string) when you generate a self-signed certificate. The other information is optional. Use a fully qualified name if such names are supported on your network. The certificate appears after you enter this information.

Installing a Key Pair and Certificate from a PKCS #12 Object File

PKCS object files provide a file format for storing and transferring storing data and cryptographic information. (For more information, see "PKCS #7, PKCS #10, and PKCS #12 Object Files" on page 417.) A PKCS #12 object file, which you obtain from a CA, includes the private key, a certificate, and optionally the CA's own certificate.

After transferring the PKCS #12 file from the CA via FTP and generating a one-time password to unlock it, you store the file in the WX switch's certificate and key store. To set and store a PKCS #12 object file, follow these steps:

1. Copy the PKCS #12 object file to nonvolatile storage on the WX. Use the following command:

   ```
   copy tftp://filename local-filename
   ```

2. Enter a one-time password (OTP) to unlock the PKCS #12 object file. The password must be the same as the password protecting the PKCS #12 file.

   The password must contain at least 1 alphanumeric character, with no spaces, and must not include the following characters:

   - Quotation marks (" ")
   - Question mark (?)
   - Ampersand (&)

   On a WX that handles communications to or from Microsoft Windows clients, use a one-time password of 31 characters or fewer.

   To enter the one-time password, use the following command:

   ```
   crypto otp {admin | eap | web} one-time-password
   ```

3. Unpack the PKCS #12 object file into the certificate and key storage area on the WX switch. Use the following command:

   ```
   crypto pkcs12 {admin | eap | web} filename
   ```

   The *filename* is the location of the file on the WX switch.

MSS erases the OTP password entered with the ***crypto otp*** *command when you enter the* ***crypto pkcs12*** *command.*

Creating a CSR and Installing a Certificate from a PKCS #7 Object File

After creating a public-private key pair, you can obtain a signed certificate of authenticity from a CA by generating a Certificate Signing Request (CSR) from the WX switch. A CSR is a text block with an encoded request for a signed certificate from the CA.

Many certificate authorities have their own unique requirements. Follow the instructions in the documentation for your CA to properly format the fields you complete when generating a CSR.

1 To generate a request for a CA-signed certificate, use the following command:

```
crypto generate request {admin | eap | web}
```

When prompted, enter values for each of six identification fields.

You must include a common name (string) when you generate a CSR. Use a fully qualified name if such names are supported on your network. The other information is optional. For example:

You must paste the entire block, from the beginning -----BEGIN CERTIFICATE REQUEST----- to the end -----END CERTIFICATE REQUEST-----.

```
# crypto generate request admin
Country Name: US
State Name: MI
Locality Name: Detroit
Organizational Name: example
Organizational Unit: eng
Common Name: WX-34
Email Address: admin@example.com
Unstructured Name: south tower, wiring closet 125
```

When completed successfully, the command returns a Privacy-Enhanced Mail (PEM)-formatted PKCS #10 CSR. PEM encoding is a way of representing a non-ASCII file format in ASCII characters. The encoded object is the PKCS #10 CSR. Give the CSR to a CA and receive a signed certificate (a PEM-encoded PKCS #7 object file).

1 To install a certificate from a PKCS #7 file, use the following command to prepare the switch to receive it:

```
crypto certificate {admin | eap | web} PEM-formatted
certificate
```

2 Use a text editor to open the PKCS #7 file, and copy and paste the entire text block, including the beginning and ending delimiters, into the CLI.

You must paste the entire block, from the beginning -----BEGIN CERTIFICATE----- to the end -----END CERTIFICATE-----.

Installing a CA's Own Certificate

If you installed a CA-signed certificate from a PKCS #7 file, you must also install the PKCS #7 certificate of that CA. (If you used the PKCS #12 method, the CA's certificate is usually included with the key pair and server certificate.)

To install a CA's certificate, use the following command:

```
crypto ca-certificate {admin | eap | web}
PEM-formatted-certificate
```

When prompted, paste the certificate under the prompt. For example:

You must paste the entire block, from the beginning -----BEGIN CERTIFICATE REQUEST----- to the end -----END CERTIFICATE REQUEST-----.

```
# crypto ca-certificate admin
Enter PEM-encoded certificate
-----BEGIN CERTIFICATE-----
MIIDwDCCA2qgAwIBAgIQL2jvuu4PO5FAQCyewU3ojANBgkqhkiG9wOBAQUFA
mzerMClaweVQQTTooewi\wpoer0QWNFNkj90044mbdrl1277SWQ8G7DiwYUt
.....
Lm8wmVYxP56M;CUAm908C2foYgOY40=
-----END CERTIFICATE-----
```

Displaying Certificate and Key Information

To display information about certificates installed on a WX switch, use the following commands:

```
display crypto ca-certificate {admin | eap | web}
display crypto certificate {admin | eap | web}
```

For example, to display information about an administrative certificate, type the following command:

You must paste the entire block, from the beginning -----BEGIN CERTIFICATE REQUEST----- to the end -----END CERTIFICATE REQUEST-----.

```
# display crypto certificate admin
Certificate:
  Version: 3
  Serial Number:  999 (0x3e7)
  Subject: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Signature Algorithm: md5WithRSAEncryption
  Issuer: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Validity:
      Not Before: Oct 19 01:57:13 2004 GMT
      Not After : Oct 19 01:57:13 2005 GMT
```

The last two rows of the display indicate the period for which the certificate is valid. Make sure the date and time set on the switch are within the date and time range of the certificate.

Key and Certificate Configuration Scenarios

The first scenario shows how to generate self-signed certificates. The second scenario shows how to install CA-signed certificates using PKCS #12 object files, and the third scenario shows how to install CA-signed certificates using CSRs (PKCS #10 object files) and PKCS #7 object files.

(For SSH configuration information, see "Managing SSH" on page 113.)

Creating Self-Signed Certificates

To manage the security of the WX switch for administrative access by 3Com Wireless Switch Manager and Web Manager, and the security of communication with 802.1X users and Web AAA users, create Admin, EAP, and Web AAA public-private key pairs and self-signed certificates. Follow these steps:

1. Set time and date parameters, if not already set. (See "Configuring and Managing Time Parameters" on page 124.)
2. Generate public-private key pairs:

```
WX1200# crypto generate key admin 1024
key pair generated
WX1200# crypto generate key eap 1024
key pair generated
WX1200# crypto generate key web 1024
key pair generated
```

3. Generate self-signed certificates:

```
WX1200# crypto generate self-signed admin
Country Name: US
State Name: CA
Locality Name: San Francisco
Organizational Name: example
Organizational Unit: IT
Common Name: WX 6
Email Address: admin@example.com
Unstructured Name: WX in wiring closet 4
success: self-signed cert for admin generated
WX1200# crypto generate self-signed eap
Country Name: US
State Name: CA
Locality Name: San Francisco
Organizational Name: example
Organizational Unit: IT
Common Name: WX 6
Email Address: admin@example.com
```

```
Unstructured Name: WX in wiring closet 4
Self-signed cert for eap is
WX1200# crypto generate self-signed web
Country Name: US
State Name: CA
Locality Name: San Francisco
Organizational Name: example
Organizational Unit: IT
Common Name: WX 6
Email Address: admin@example.com
Unstructured Name: WX in wiring closet 4
success: self-signed cert for web generated
```

4 Display certificate information for verification:

```
WX1200# display crypto certificate admin
Certificate:
  Version: 3
  Serial Number:  999 (0x3e7)
  Subject: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Signature Algorithm: md5WithRSAEncryption
  Issuer: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Validity:
      Not Before: Oct 19 01:57:13 2004 GMT
      Not After : Oct 19 01:57:13 2005 GMT
WX1200# display crypto certificate eap
Certificate:
  Version: 3
  Serial Number:  999 (0x3e7)
  Subject: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Signature Algorithm: md5WithRSAEncryption
  Issuer: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Validity:
      Not Before: Oct 19 01:59:42 2004 GMT
      Not After : Oct 19 01:59:42 2005 GMT
```

```
WX1200# display crypto certificate web
Certificate:
  Version: 3
  Serial Number:  999 (0x3e7)
  Subject: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Signature Algorithm: md5WithRSAEncryption
  Issuer: C=US, ST=CA, L=PLEAS, O=Mycorp, OU=SQA,
CN=BOBADMIN/emailAddress=BOBADMIN, unstructuredName=BOB
  Validity:
      Not Before: Oct 19 02:02:02 2004 GMT
      Not After : Oct 19 02:02:02 2005 GMT
```

Installing CA-Signed Certificates from PKCS #12 Object Files

This scenario shows how to use PKCS #12 object files to install public-private key pairs, CA-signed certificates, and CA certifies for administrative access, 802.1X (EAP) access, and Web AAA access.

1. Set time and date parameters, if not already set. (See "Configuring and Managing Time Parameters" on page 124.)
2. Obtain PKCS #12 object files from a certificate authority.
3. Copy the PKCS #12 object files to nonvolatile storage on the WX. Use the following command:

   ```
   copy tftp://filename local-filename
   ```

   For example, to copy PKCS #12 files named 2048admn.p12, 20481x.p12, and 2048web.p12 from the TFTP server at the address 192.168.253.1, type the following commands:

   ```
   WX1200# copy tftp://192.168.253.1/2048admn.p12 2048admn.p12
   success: received 637 bytes in 0.253 seconds [ 2517
   bytes/sec]
   WX1200# copy tftp://192.168.253.1/20481x.p12 20481x.p12
   success: received 637 bytes in 0.253 seconds [ 2517
   bytes/sec]
   WX1200# copy tftp://192.168.253.1/2048web.p12 2048web.p12
   success: received 637 bytes in 0.253 seconds [ 2517
   bytes/sec]
   ```

4. Enter the one-time passwords (OTPs) for the PKCS #12 object files. The OTP protects the PKCS #12 file.

   To enter a one-time password, use the following command:

   ```
   crypto otp {admin | eap | web} one-time-password
   ```

For example:

```
WX1200# crypto otp admin SeC%#6@o%c
OTP set
WX1200# crypto otp eap SeC%#6@o%d
OTP set
WX1200# crypto otp web SeC%#6@o%e
OTP set
```

5 Unpack the PKCS #12 object files into the certificate and key storage area on the WX switch. Use the following command:

`crypto pkcs12 {admin | eap | web} filename`

The *filename* is the location of the file on the WX switch.

For example:

```
WX1200# crypto pkcs12 admin 2048admn.p12
Unwrapped from PKCS12 file:
        keypair
        device certificate
        CA certificate
WX1200# crypto pkcs12 eap 20481x.p12
Unwrapped from PKCS12 file:
        keypair
        device certificate
        CA certificate
WX1200# crypto pkcs12 web 2048web.p12
Unwrapped from PKCS12 file:
        keypair
        device certificate
        CA certificate
```

MSS erases the OTP password entered with the ***crypto otp*** *command when you enter the* ***crypto pkcs12*** *command.*

Installing CA-Signed Certificates Using a PKCS #10 Object File (CSR) and a PKCS #7 Object File

This scenario shows how to use CSRs to install public-private key pairs, CA-signed certificates, and CA certifies for administrative access, 802.1X (EAP) access, and Web AAA access.

1. Set time and date parameters, if not already set. (See "Configuring and Managing Time Parameters" on page 124.)
2. Generate public-private key pairs:

```
WX1200# crypto generate key admin 1024
key pair generated
WX1200# crypto generate key eap 1024
key pair generated
WX1200# crypto generate key web 1024
key pair generated
```

3. Create a CSR (PKCS #10 object file) to request an administrative certificate:

```
WX1200# crypto generate request admin
Country Name: US
State Name: CA
Locality Name: Cambria
Organizational Name: example
Organizational Unit: eng
Common Name: WX-2
Email Address: admin@example.com
Unstructured Name: wiring closet 12
CSR for admin is
-----BEGIN CERTIFICATE REQUEST-----
MIIBdTCB3wIBADA2MQswCQYDVQQGEwJVUzELMAkGA1UECBMCQ0ExGjAYBgNV
EXRlY2hwdWJzQHRycHouY29tMIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKB
...
2L8Q9tk+G2As84QYMwe9RJAjfbYM5bdWRUFiLzvK7BJgqBsCZz4DP00=
-----END CERTIFICATE REQUEST-----
```

4. Copy the CSR into the CA's application.
5. Transfer the signed administrative certificate (PKCS #7 object file) from the CA to your computer.
6. Open the signed certificate file with a text editor. Copy the entire file from the first hyphen to the last.

7 To install the administrative certificate on the WX switch, type the following command to display a prompt:

```
WX1200# crypto certificate admin
Enter PEM-encoded certificate
```

8 Paste the signed certificate text block into the WX switch's CLI, below the prompt.

9 Display information about the certificate, to verify it:

```
WX1200# display crypto certificate admin
```

10 Repeat step 3 through step 9 to obtain and install EAP (802.1X) and Web AAA certificates.

11 Obtain the CA's own certificate.

12 To install the CA's certificate on the WX switch and help authenticate the switch's Admin certificate, type the following command to display a prompt:

```
WX1200# crypto ca-certificate admin
Enter PEM-encoded certificate
```

13 Paste the CA's signed certificate under the prompt.

14 Display information about the CA's certificate, to verify it:

```
WX1200# display crypto ca-certificate admin
```

15 Repeat step 12 through step 14 to install the CA's certificate for EAP (802.1X) and Web AAA.

21

CONFIGURING AAA FOR NETWORK USERS

The following sections describe the MSS authentication, authorization, and accounting (AAA) features in detail.

About AAA for Network Users

Network users include the following types of users:

- **Wireless users** — Users who access the network by associating with an SSID on a 3Com radio.
- **Wired authentication users** — Users who access the network over an Ethernet connection to a WX switch port that is configured as a wired authentication (*wired-auth*) port.

You can configure authentication rules for each type of user, on an individual SSID or wired authentication port basis. MSS authenticates users based on user information on RADIUS servers or in the WX switch's local database. The RADIUS servers or local database authorize successfully authenticated users for specific network access, including VLAN membership. Optionally, you also can configure accounting rules to track network access information.

Authentication

When a user attempts to access the network, MSS checks for an authentication rule that matches the following parameters:

- For wireless access, the authentication rule must match the SSID the user is requesting, and the user's username or MAC address.
- For access on a wired authentication port, the authentication rule must match the user's username or MAC address.

If a matching rule is found, MSS then checks RADIUS servers or the WX local user database for credentials that match those presented by the user. Depending on the type of authentication rule that matches the SSID or wired authentication port, the required credentials are the username or MAC address, and in some cases, a password.

Each authentication rule specifies where the user credentials are stored. The location can be a group of RADIUS servers or the switch's local database. In either case, if MSS has an authentication rule that matches on the required parameters, MSS checks the username or MAC address of the user and, if required, the password to make sure they match the information configured on the RADIUS servers or in the local database.

The username or MAC address can be an exact match or can match a userglob or MAC address glob, which allow wildcards to be used for all or part of the username or MAC address. (For more information about globs, see "AAA Tools for Network Users" on page 441.)

Authentication Types

MSS provides the following types of authentication:

- **IEEE 802.1X** — If the network user's network interface card (NIC) supports 802.1X, MSS checks for an 802.1X authentication rule that matches the username (and SSID, if wireless access is requested), and that uses the Extensible Authentication Protocol (EAP) requested by the NIC. If a matching rule is found, MSS uses the requested EAP to check the RADIUS server group or local database for the username and password entered by the user. If matching information is found, MSS grants access to the user.
- **MAC** — If the username does not match an 802.1X authentication rule, but the MAC address of the user NIC or Voice-over-IP (VoIP) phone and the SSID (if wireless) do match a MAC authentication rule, MSS checks the RADIUS server group or local database for matching user information. If the MAC address (and password, if on a RADIUS server) matches, MSS grants access. Otherwise, MSS attempts the fallthru authentication type, which can be Web, last-resort, or none. (Fallthru authentication is described in more detail in "Authentication Algorithm" on page 435.)
- **Web** — A network user attempts to access a web page over the network. The WX switch intercepts the HTTP or HTTPS request and serves a login Web page to the user. The user enters the username and password, and MSS checks the RADIUS server group or local database for matching user information. If the username and password match, MSS redirects the user to the web page she requested. Otherwise, MSS denies access to the user.
- **Last-resort**—A network user associates with an SSID or connects to a wired authentication port, and does not enter a username or password.

- **SSID**—If 802.1X or MAC authentication do not apply to the SSID (no 802.1X or MAC access rules are configured for the SSID), the default authorization attributes set on the SSID are applied to the user and the user is allowed onto the network.
- **Wired authentication port**—If 802.1X or MAC authentication do not apply to the port (no 802.1X or MAC access rules have the wired option set), MSS checks for user last-resort-wired. If this user is configured, the authorization attributes set for the user are applied to the user who is on the wired authentication port and the user is allowed onto the network.

Authentication Algorithm

MSS can try more than one of the authentication types described in “Authentication Types” to authenticate a user. MSS tries 802.1X first. If the user NIC supports 802.1X but fails authentication, MSS denies access. Otherwise, MSS tries MAC authentication next. If MAC authentication is successful, MSS grants access to the user. Otherwise, MSS tries the *fallthru* authentication type specified for the SSID or wired authentication port. The fallthru authentication type can be one of the following:

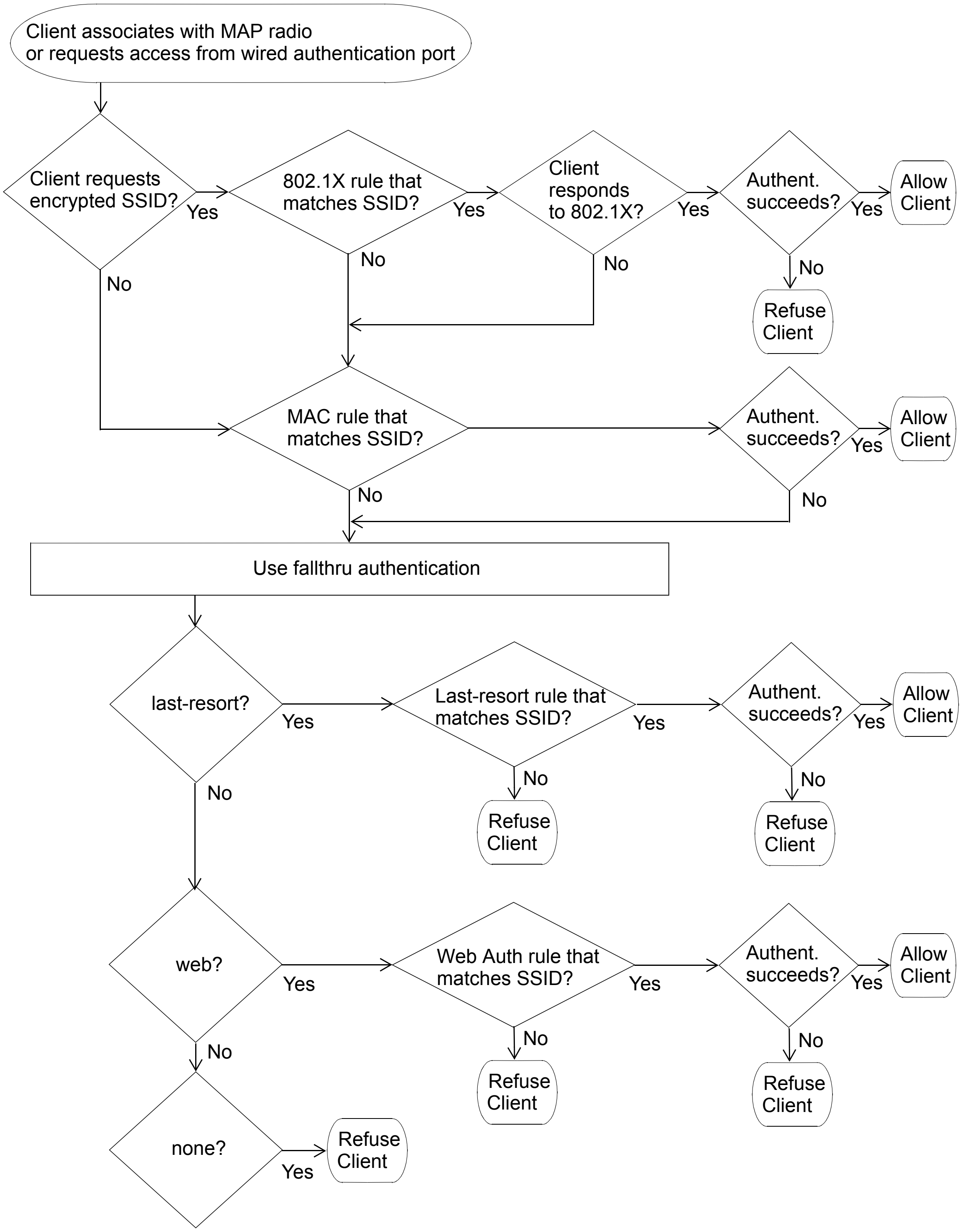
- Web
- Last-resort
- None

Web and last-resort are described in “Authentication Types”. None means the user is automatically denied access. The fallthru authentication type for wireless access is associated with the SSID (through a service profile). The fallthru authentication type for wired authentication access is specified with the wired authentication port. (For information about service profiles, see “Service Profiles” on page 202. For information about wired authentication port configuration, see “Setting a Port for a Wired Authentication User” on page 75.)

The fallthru authentication type None is different from the authentication method ***none*** *you can specify for administrative access. The fallthru authentication type None denies access to a network user. In contrast, the authentication method* ***none*** *allows access to the WX switch by an administrator. (See “Configuring AAA for Administrative and Local Access” on page 51.)*

Figure 30 shows how MSS tries the authentication types. (The authentication process is similar for access through a wired authentication port, except last-resort access requires a last-resort-wired user.)

Figure 30 Authentication Flowchart for Network Users


Client associates with MAP radio
or requests access from wired authentication port
Client requests encrypted SSID?
Yes
No
802.1X rule that matches SSID?
Yes
No
Client responds to 802.1X?
Yes
No
Authent. succeeds?
Yes
Allow Client
No
Refuse Client
MAC rule that matches SSID?
No
Authent. succeeds?
Yes
Allow Client
No
Use fallthru authentication
last-resort?
Yes
No
Last-resort rule that matches SSID?
Yes
No
Refuse Client
Authent. succeeds?
Yes
Allow Client
No
Refuse Client
web?
Yes
No
Web Auth rule that matches SSID?
Yes
No
Refuse Client
Authent. succeeds?
Yes
Allow Client
No
Refuse Client
none?
Yes
Refuse Client

SSID Name "Any"

In authentication rules for wireless access, you can specify the name *any* for the SSID. This value is a wildcard that matches on any SSID string requested by the user.

For 802.1X and WebAAA rules that match on SSID *any*, MSS checks the RADIUS servers or local database for the username (and password, if applicable) entered by the user. If the user information matches, MSS grants access to the SSID requested by the user, regardless of which SSID name it is.

For MAC authentication rules that match on SSID *any*, MSS checks the RADIUS servers or local database for the MAC address (and password, if applicable) of the user device. If the address matches, MSS grants access to the SSID requested by the user, regardless of which SSID name it is.

Last-Resort Processing

One of the fallthru authentication types you can set on a service profile or wired authentication port is **last-resort**.

If no 802.1X or MAC access rules are configured for a service profile's SSID, and the SSID's fallthru type is **last-resort**, MSS allows users onto the SSID or port without prompting for a username or password. The default authorization attributes set on the SSID are applied to the user. For example, if the vlan-name attribute on the service profile is set to *guest-vlan*, last-resort users are placed in *guest-vlan*.

If no 802.1X or MAC access rules are configured for **wired**, and the wired authentication port's fallthru type is **last-resort**, MSS allows users onto the port without prompting for a username or password. The authorization attributes set on user *last-resort-wired* are applied to the user.

User Credential Requirements

The user credentials that MSS checks for on RADIUS servers or in the local database differ depending on the type of authentication rule that matches on the SSID or wired access requested by the user.

- For a user to be successfully authenticated by an 802.1X or WebAAA rule, the username and password entered by the user must be configured on the RADIUS servers used by the authentication rule or in the WX local database, if the local database is used by the rule.

- For a user to be successfully authenticated based on the MAC address of the user device, the MAC address must be configured on the RADIUS servers used by the authentication rule or in the WX local database, if the local database is used by the rule. If the MAC address is configured in the local database, no password is required. However, since RADIUS requires a password, if the MAC address is on the RADIUS server, MSS checks for a password. By default, MSS assumes that the MAC address for a MAC user is also the password.
- For a user to be successfully authenticated for last-resort access on a wired authentication port, the RADIUS servers or local database must contain a user named last-resort-wired. If the last-resort-wired user is configured in the local database, no password is required. However, since RADIUS requires a password, if the last-resort-wired user is on the RADIUS server, MSS checks for a password. The default well-known password is *3Com* but is configurable. (The same password applies to MAC users.)

  Last-resort access to an SSID does not require a special user (such as *last-resort-**ssid***) to be configured. Instead, if the fallthru authentication type on the SSID's service profile is set to **last-resort**, and the SSID does not have any 802.1X or MAC access rules, a user can access the SSID without entering a username or password.

Authorization

If the user is authenticated, MSS then checks the RADIUS server or local database (the same place MSS looked for user information to authenticate the user) for the authorization attributes assigned to the user. Authorization attributes specify the network resources the user can access.

The only required attribute is the Virtual LAN (VLAN) name on which to place the user. RADIUS and MSS have additional optional attributes. For example, you can provide further access controls by specifying the times during which the user can access the network, you can apply inbound and outbound access control lists (ACLs) to the user traffic, and so on.

To assign attributes on the RADIUS server, use the standard RADIUS attributes supported on the server. To assign attributes in the WX switch's local database, use the MSS vendor-specific attributes (VSAs).

The RADIUS attributes supported by MSS are described in Appendix C, "Supported RADIUS Attributes" on page 651.

MSS provides the following VSAs, which you can assign to users configured in the local database or on a RADIUS server:

- **Encryption-Type** — Specifies the type of encryption required for access by the client. Clients who attempt to use an unauthorized encryption method are rejected.
- **End-Date** — Date and time after which the user is no longer allowed to be on the network.
- **Mobility-Profile** — Controls the WX switch ports a user can access. For wireless users, an MSS Mobility Profile specifies the MAPs through which the user can access the network. For wired authentication users, the Mobility Profile specifies the wired authentication ports through which the user can access the network.
- **SSID** — SSID the user is allowed to access after authentication.
- **Start-Date** — Date and time at which the user becomes eligible to access the network. MSS does not authenticate the user unless the attempt to access the network occurs at or after the specified date and time, but before the end-date (if specified).
- **Time-of-Day** — Day(s) and time(s) during which the user is permitted to log into the network.
- **URL** — URL to which the user is redirected after successful WebAAA.
- **VLAN-Name** — VLAN to place the user on.

You also can assign the following RADIUS attributes to users configured in the local database.

- **Filter-Id** — Security ACL that permits or denies traffic received by (input) or sent by (output) the user.
- **Service-Type** — Type of access the user is requesting, which can be network access, administrative access to the enabled (configuration) mode of the MSS CLI, or administrative access to the nonenabled mode of the CLI
- **Session-Timeout** — Maximum number of seconds allowed for the user session.

Regardless of whether you configure the user and attributes on RADIUS servers or the WX local database, the VLAN attribute is required. The other attributes are optional.

In addition to configuring authorization attributes for users on RADIUS servers or the WX local database, you can also configure attributes within a service profile. These authorization attributes are applied to users accessing the SSID managed by the service profile (in addition to any attributes supplied by a RADIUS server or the WX local database).

Accounting

MSS also supports accounting. Accounting collects and sends information used for billing, auditing, and reporting — for example, user identities, connection start and stop times, the number of packets received and sent, and the number of bytes transferred. You can track sessions through accounting information stored locally or on a remote RADIUS server. As network users roam throughout a Mobility Domain, accounting records track them and their network usage.

Summary of AAA Features

Depending on your network configuration, you can configure authentication, authorization, and accounting (AAA) for network users to be performed locally on the WX switch or remotely on a RADIUS server. The number of users that the local WX database can support depends on your platform.

AAA for network users controls and monitors their use of the network:

- **Classification for customized access.** As with administrative and console users, you can classify network users through username globbing. Based on the structured username, different AAA treatments can be given to different classes of user. For example, users in the human resources department can be authenticated differently from users in the sales department.
- **Authentication for full or limited access.** IEEE 802.1X network users are authenticated when they identify themselves with a credential. Authentication can be passed through to RADIUS, performed locally on the WX switch, or only partially “offloaded” to the switch. Network users without 802.1X support can be authenticated by the MAC addresses of their devices. If neither 802.1X nor MAC authentication apply to the user, they can still be authenticated by a *fallthru* method, either WebAAA or last-resort authentication. Optionally, you can disable the fallthru option by setting the fallthru type to none.

- **Authorization for access control.** Authorization provides access control by means of such mechanisms as per-user security access control lists (ACLs), VLAN membership, Mobility Domain assignment, and timeout enforcement. Because authorization is always performed on network access users so they can use a particular VLAN, the WX automatically uses the same AAA method (RADIUS server group or local database) for authorization that you define for a user authentication.
- **Local authorization control.** You can override any AAA assignment of VLAN or security ACL for individual network users on a particular WX switch by configuring the location policy on the WX.
- **SSID default authorization attributes.** You can configure service profiles with a set of default AAA authorization attributes that are used when the normal AAA process or a location policy does not provide them.
- **Accounting for tracking users and resources.** Accounting collects and sends information used for billing, auditing, and reporting — for example, user identities, connection start and stop times, the number of packets received and sent, and the number of bytes transferred. You can track sessions through accounting information stored locally or on a remote RADIUS server. As network users roam throughout a Mobility Domain, accounting records track them and their network usage.

AAA Tools for Network Users

Authentication verifies network user identity and is required before a network user is granted access to the network. A WX switch authenticates user identity by username-password matching, digital signatures and certificates, or other methods (for example, by MAC address).

You must decide whether to authenticate network users locally on the WX, remotely via one or more external RADIUS server groups, or both locally and remotely. (For server group details, see “Configuring RADIUS Server Groups” on page 524.)

"Globs" and Groups for Network User Classification

"Globbing" lets you classify users by username or MAC address for different AAA treatments. A user glob is a string used by AAA and IEEE 802.1X or WebAAA methods to match a user or set of users. MAC address globs match authentication methods to a MAC address or set of MAC addresses. User globs and MAC address globs can make use of wildcards. For details, see "User Globs, MAC Address Globs, and VLAN Globs" on page 30.

A user group is a named collection of users or MAC addresses sharing a common authorization policy. For example, you might group all users on the first floor of building 17 into the group *bldg-17-1st-floor*, or group all users in the IT group into the group *infotech-people*.

Wildcard "Any" for SSID Matching

Authentication rules for wireless access include the SSID name, and must match on the SSID name requested by the user for MSS to attempt to authenticate the user for that SSID. To make an authentication rule match an any SSID string, specify the SSID name as **any** in the rule.

AAA Methods for IEEE 802.1X and Web Network Access

The following AAA methods are supported by 3Com for 802.1X and Web network access mode:

- Client certificates issued by a certificate authority (CA) for authentication.

  (For this method, you assign an authentication protocol to a user. For protocol details, see "IEEE 802.1X Extensible Authentication Protocol Types" on page 446.)

- The WX local database of usernames and user groups for authentication.

  (For configuration details, see "Adding and Clearing Local Users for Administrative Access" on page 59, "Authenticating via a Local Database" on page 450, and "Adding and Clearing MAC Users and User Groups Locally" on page 456.)

- A named group of RADIUS servers. The WX switch supports up to four server groups, which can each contain between one and four servers.

  (For server group details, see "Configuring RADIUS Server Groups" on page 524.)

You can use the local database or RADIUS servers for MAC access as well. If you use RADIUS servers, make sure you configure the password for the MAC address user as *3Com*. (This is the default authorization password. To change it, see "Changing the MAC Authorization Password for RADIUS" on page 459.)

AAA Rollover Process

A WX switch attempts AAA methods in the order in which they are entered in the configuration:

1. The first AAA method in the list is used unless that method results in an error. If the method results in a pass or fail, the result is final and the WX tries no other methods.
2. If the WX switch receives no response from the first AAA method, it tries the second method in the list.
3. If the WX switch receives no response from the second AAA method, it tries the third method. This evaluation process is applied to all methods in the list.

If a AAA rule specifies local as a secondary AAA method, to be used if the RADIUS servers are unavailable, and MSS authenticates a client with the local method, MSS starts again at the beginning of the method list when attempting to authorize the client. This can cause unexpected delays during client processing and can cause the client to time out before completing logon.

Local Override Exception

The one exception to the operation described in "AAA Rollover Process" takes place if the local database is the *first* method in the list and is followed by a RADIUS server group method. If the local method fails to find a matching username entry in the local database, the WX switch tries the next RADIUS server group method. This exception is referred to as local override*.*

If the local database is the *last* method in the list, however, local authentication must either accept or deny the user, because it has no other method to roll over to.

Remote Authentication with Local Backup

You can use a combination of authentication methods; for example, PEAP offload and local authentication. When PEAP offload is configured, the WX switch offloads all EAP processing from server groups; the RADIUS servers are not required to communicate using the EAP protocols. (For details, see "Configuring EAP Offload" on page 449.) In the event that RADIUS servers are unavailable, local authentication takes place, using the database on the WX switch.

Suppose an administrator wants to rely on RADIUS servers and also wants to ensure that a certain group of users always gets access. As shown in the following example, the administrator can enable PEAP offload, so that authentication is performed by a RADIUS server group as the first method for these users, and configure local authentication last, in case the RADIUS servers are unavailable. (See Figure 31.)

1. To configure *server-1* and *server-2* at IP addresses 192.168.253.1 and 192.168.253.2 with the password *chey3nn3*, the administrator enters the following commands:

```
WX1200# set radius server server-1 address 192.168.253.1 key chey3nn3
WX1200# set radius server server-2 address 192.168.253.2 key chey3nn3
```

2. To configure *server-1* and *server-2* into *server-group-1*, the administrator enters the following command:

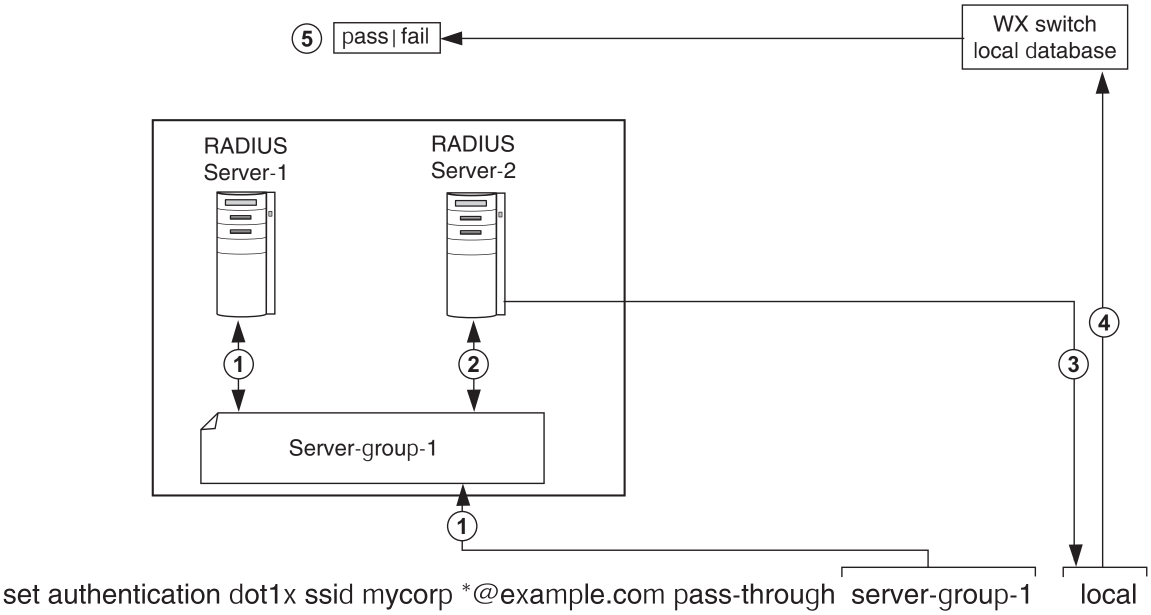
```
WX1200# set server group server-group-1 members server-1 server-2
```

3. To enable PEAP offload plus local authentication for all users of SSID *mycorp* at @example.com, the administrator enters the following command.

```
WX1200# set authentication dot1x ssid mycorp *@example.com pass-through
server-group-1 local
```

Figure 31 shows the results of this combination of methods.

Figure 31 Remote Authentication with PEAP Offload using Local Authentication as Backup


⑤ pass | fail
WX switch local database
RADIUS Server-1
RADIUS Server-2
①
②
③
④
Server-group-1
①
set authentication dot1x ssid mycorp *@example.com pass-through server-group-1 local

Authentication proceeds as follows:

1 When user Jose@example.com attempts authentication, the WX switch sends an authentication request to the first AAA method, which is *server-group-1.*

Because *server-group-1* contains two servers, the first RADIUS server, *server-1*, is contacted. If this server responds, the authentication proceeds using *server-1*.

2 If *server-1* fails to respond, the WX retries the authentication using *server-2*. If *server-2* responds, the authentication proceeds using *server-2*.

3 If *server-2* does not respond, because the WX switch has no more servers to try in *server-group-1*, the WX attempts to authenticate using the next AAA method, which is the *local* method.

4 The WX switch consults its local database for an entry that matches Jose@example.com.

5 If a suitable local database entry exists, the authentication proceeds. If not, authentication fails and Jose@example.com is not allowed to access the network.

If one of the RADIUS servers in the group does respond, but it indicates that the user does not exist on the RADIUS server, or that the user is not permitted on the network, then authentication for the user fails, regardless of any additional methods. Only if all the RADIUS servers in the server group do not respond does the WX attempt to authenticate using the next method in the list.

Also note that if the primary authentication method is local and the secondary method is RADIUS, but the user does not exist in the local database, then the WX does attempt to authenticate using RADIUS. See "Local Override Exception" on page 443.

Using pass-through authentication as the primary authentication method and the local database as the secondary authentication method is not supported.

IEEE 802.1X Extensible Authentication Protocol Types

Extensible Authentication Protocol (EAP) is a generic point-to-point protocol that supports multiple authentication mechanisms. EAP has been adopted as a standard by the Institute of Electrical and Electronic Engineers (IEEE). IEEE 802.1X is an encapsulated form for carrying authentication messages in a standard message exchange between a user (client) and an authenticator.

Table 38 summarizes the EAP protocols (also called types or methods) supported by MSS.

Table 38 EAP Authentication Protocols for Local Processing

EAP Type	Description	Use	Considerations
EAP-MD5 (EAP with Message Digest Algorithm 5)	Authentication algorithm that uses a challenge-response mechanism to compare hashes	Wired authentication only*	This protocol provides no encryption or key establishment.
EAP-TLS (EAP with Transport Layer Security)	Protocol that provides mutual authentication, integrity-protected encryption algorithm negotiation, and key exchange. EAP-TLS provides encryption and data integrity checking for the connection.	Wireless and wired authentication. All authentication is processed on the WX switch.	This protocol requires X.509 public key certificates on both sides of the connection. Requires use of local database. Not supported for RADIUS.

Table 38 EAP Authentication Protocols for Local Processing (continued)

EAP Type	Description	Use	Considerations
PEAP-MS-CHAP-V2 (Protected EAP with Microsoft Challenge Handshake Authentication Protocol version 2)	The wireless client authenticates the server (either the WX switch or a RADIUS server) using TLS to set up an encrypted session. Mutual authentication is performed by MS-CHAP-V2.	Wireless and wired authentication: ▪ The PEAP portion is processed on the WX switch. ▪ The MS-CHAP-V2 portion is processed on the RADIUS server or locally, depending on the configuration.	Only the server side of the connection requires a certificate. The client needs only a username and password.

* EAP-MD5 does not work with Microsoft wired authentication clients.

Ways a WX Switch Can Use EAP

Network users with 802.1X support cannot access the network unless they are authenticated. You can configure a WX switch to authenticate users with EAP on a group of RADIUS servers and/or in a local user database on the WX, or to offload some authentication tasks from the server group. Table 39 details these three basic WX authentication approaches.

(For information about digital certificates, see Chapter 20, "Managing Keys and Certificates," on page 413.)

Table 39 Three Basic WX Approaches to EAP Authentication

Approach	Description
Pass-through	An EAP session is established directly between the client and RADIUS server, passing through the WX switch. User information resides on the server. All authentication information and certificate exchanges pass through the switch or use client certificates issued by a certificate authority (CA). In this case, the switch does not need a digital certificate, although the client might.
Local	The WX switch performs all authentication using information in a local user database configured on the switch, or using a client-supplied certificate. No RADIUS servers are required. In this case, the switch needs a digital certificate. If you plan to use the EAP with Transport Layer Security (EAP-TLS) authentication protocol, the clients also need certificates.

Table 39 Three Basic WX Approaches to EAP Authentication (continued)

Approach	Description
Offload	The WX switch offloads all EAP processing from a RADIUS server by establishing a TLS session between the switch and the client. In this case, the switch needs a digital certificate. When you use offload, RADIUS can still be used for non-EAP authentication and authorization.

Effects of Authentication Type on Encryption Method

Wireless users who are authenticated on an encrypted service set identifier (SSID) can have their data traffic encrypted by the following methods:

- Wi-Fi Protected Access (WPA) encryption
- Non-WPA dynamic Wired Equivalent Privacy (WEP) encryption
- Non-WPA static WEP encryption

(For encryption details, see Chapter 13, “Configuring User Encryption,” on page 281.)

The authentication method you assign to a user determines the encryption available to the user. Users configured for EAP authentication, MAC authentication, Web, or last-resort authentication can have their traffic encrypted as shown in Table 40.

Table 40 Encryption Available to Various Authentication Methods

Eap Authentication	MAC Authentication	Last-Resort	WebAAA
WPA encryption	Static WEP	Static WEP	Static WEP
Dynamic WEP encryption	No encryption (if SSID is unencrypted)	No encryption (if SSID is unencrypted)	No encryption (if SSID is unencrypted)

Wired users are not eligible for the encryption performed on the traffic of wireless users, but they can be authenticated by an EAP method, a MAC address, or a Web login page served by the WX switch.

Configuring 802.1X Authentication

The IEEE 802.1X standard is a framework for passing EAP protocols over a wired or wireless LAN. Within this framework, you can use TLS, PEAP-TTLS, or EAP-MD5. Most EAP protocols can be passed through the WX switch to the RADIUS server. Some protocols can be processed locally on the WX switch.

The following 802.1X authentication command allows differing authentication treatments for multiple users:

```
set authentication dot1x {ssid ssid-name | wired} user-glob
[bonded] protocol method1 [method2] [method3] [method4]
```

For example, the following command authenticates wireless user *Tamara*, when requesting SSID *wetlands*, as an 802.1X user using the PEAP-MS-CHAP-V2 method via the server group *shorebirds*, which contains one or more RADIUS servers:

```
WX1200# set authentication dot1x ssid wetlands Tamara
peap-mschapv2 shorebirds
```

When a user attempts to connect through 802.1X, the following events occur:

1. For each 802.1X login attempt, MSS examines each command in the configuration file in strict configuration order.
2. The first command whose SSID and user glob matches the SSID and incoming username is used to process this authentication. The command determines exactly how this particular login attempt is processed by the WX switch.

(For more information about user globs, see “User Globs” on page 30.)

Configuring EAP Offload

You can configure the WX switch to offload all EAP processing from server groups. In this case, the RADIUS server is not required to communicate using the EAP protocols.

For PEAP-MS-CHAP-V2 offload, you define a complete user profile in the local WX database and only a username and password on a RADIUS server.

For example, the following command authenticates all wireless users who request SSID *marshes* at example.com by offloading PEAP processing onto the WX switch, while still performing MS-CHAP-V2 authentication via the server group *shorebirds*:

```
WX1200# set authentication dot1x ssid marshes *@example.com
peap-mschapv2 shorebirds
```

To offload *both* PEAP and MS-CHAP-V2 processing onto the WX switch, use the following command:

```
WX1200# set authentication dot1x ssid marshes *@example.com
peap-mschapv2 local
```

Using Pass-Through

The pass-through method causes EAP authentication requests to be processed entirely by remote RADIUS servers in server groups.

For example, the following command enables users at EXAMPLE to be processed via server group *shorebirds* or *swampbirds*:

```
WX1200# set authentication dot1X ssid marshes EXAMPLE/*
pass-through shorebirds swampbirds
```

The server group *swampbirds* is contacted only if all the RADIUS servers in *shorebirds* do not respond.

(For an example of the use of pass-through servers plus the local database for authentication, see "Remote Authentication with Local Backup" on page 444.)

Authenticating via a Local Database

To configure the WX switch to authenticate and authorize a user against the local database in the WX switch, use the following command:

```
set authentication dot1x {ssid ssid-name | wired} user-glob
[bonded] protocol local
```

For example, the following command authenticates 802.1X user *Jose* for wired authentication access via the local database:

```
WX1200# set authentication dot1X Jose wired
peap-mschapv2 local
success: change accepted.
```

Binding User Authentication to Machine Authentication

Bonded Auth™ (bonded authentication) is a security feature that binds an 802.1X user authentication to authentication of the machine from which the user is attempting to log on. When this feature is enabled, MSS authenticates the user only if the machine the user is on has already been authenticated.

By default, MSS does not bind user authentication to machine authentication. A trusted user can log on from any machine attached to the network.

You can use bonded authentication with Microsoft Windows clients that support separate 802.1X authentication for the machine itself and for a user who uses the machine to log on to the network.

Network administrators sometimes use machine authentication in a Microsoft Active Directory domain to run login scripts, and to control defaults, application access and updates, and so on. Bonded authentication provides an added security measure, by ensuring that a trusted user can log onto the network only from a trusted machine known to Active Directory.

For example, if user bob.mycorp.com has a trusted laptop PC used for work but also has a personal laptop PC, you might want to bind Bob's authentication with the authentication of his workplace laptop, host/bob-laptop.mycorp.com. In this case, Bob can log on to the company network only from his work laptop.

When bonded authentication is enabled, MSS retains information about the machine session when a user logs on from that machine. MSS authenticates the user only if there has already been a successful machine authentication. Evidence of the machine session in MSS indicates that the machine has successfully authenticated and is therefore trusted by MSS. If MSS does not have session information for the machine, MSS refuses to authenticate the user and does not allow the user onto the network from the unauthenticated machine.

If the 802.1X reauthentication parameter or the RADIUS Session-Timeout parameter is applicable, the user must log in before the 802.1X reauthentication timeout or the RADIUS session-timeout for the machine's session expires. Normally, these parameters apply only to clients that use dynamic WEP, or use WEP-40 or WEP-104 encryption with WPA or RSN.

Authentication Rule Requirements

Bonded authentication requires an 802.1X authentication rule for the machine itself, and a separate 802.1X authentication rule for the user(s). Use the **bonded** option in the user authentication rule, but not in the machine authentication rule.

The authentication rule for the machine must be higher up in the list of authentication rules than the authentication rule for the user.

You must use 802.1X authentication rules. The 802.1X authentication rule for the machine must use **pass-through** as the protocol. 3Com recommends that you also use **pass-through** for the user authentication rule.

The rule for the machine and the rule for the user must use a RADIUS server group as the method. (Generally, in a bonded authentication configuration, the RADIUS servers will use a user database stored on an Active Directory server.)

(For a configuration example, see “Bonded Auth Configuration Example” on page 454.)

3Com recommends that you make the rules as general as possible. For example, if the Active Directory domain is mycorp.com, the following userglobs match on all machine names and users in the domain:

- host/*.mycorp.com (userglob for the machine authentication rule)
- *.mycorp.com (userglob for the user authentication rule)

If the domain name has more nodes (for example, nl.mycorp.com), use an asterisk in each node that you want to match globally. For example, to match on all machines and users in mycorp.com, use the following userglobs:

- host/*.*.mycorp.com (userglob for the machine authentication rule)
- *.*.mycorp.com (userglob for the user authentication rule)

Use more specific rules to direct machines and users to different server groups. For example, to direct users in nl.mycorp.com to a different server group than users in de.mycorp.com, use the following userglobs:

- host/*.nl.mycorp.com (userglob for the machine authentication rule)
- *.nl.mycorp.com (userglob for the user authentication rule)
- host/*.de.mycorp.com (userglob for the machine authentication rule)
- *.de.mycorp.com (userglob for the user authentication rule)

Bonded Auth Period

The *Bonded Auth period* is the number of seconds MSS allows a Bonded Auth user to reauthenticate.

After successful machine authentication, a session for the machine appears in the session table in MSS. When the user logs on and is authenticated, the user session replaces the machine session in the table. However, since the user authentication rule contains the **bonded** option, MSS remembers that the machine was authenticated.

If a Bonded Auth user session is ended due to 802.1X reauthentication or the RADIUS Session-Timeout parameter, MSS can allow time for the user to reauthenticate. The amount of time that MSS allows for reauthentication is controlled by the Bonded Auth period.

If the user does not reauthenticate within the Bonded Auth period, MSS deletes the information about the machine session. After the machine session information is deleted, the Bonded Auth user cannot reauthenticate. When this occurs, the user will need to log off, then log back on, to access the network. After multiple failed reauthentication attempts, the user might need to reboot the PC before logging on.

By default, the Bonded Auth period is 0 seconds. MSS does not wait for a Bonded Auth user to reauthenticate.

You can set the Bonded Auth period to a value up to 300 seconds. 3Com recommends that you try 60 seconds, and change the period to a longer value only if clients are unable to authenticate within 60 seconds.

To set the Bonded Auth period, use the following command:

```
set dot1x bonded-period seconds
```

To reset the Bonded Auth period to its default value (0), use the following command:

```
clear dot1x bonded-period
```

Bonded Auth Configuration Example

To configure Bonded Auth:

- Configure separate authentication rules for the machine and for the user(s).
- Set the Bonded Auth period.
- Verify the configuration changes.

The following commands configure two 802.1X authentication rules for access to SSID *mycorp*. The first rule is for authentication of all trusted laptop PCs at mycorp.com (host/*-laptop.mycorp.com). The second rule is for bonded authentication of all users at mycorp.com (*.mycorp.com). Both rules use pass-through as the protocol, and use RADIUS server group *radgrp1*.

```
WX1200# set authentication dot1x ssid mycorp
host/*-laptop.mycorp.com pass-through radgrp1
success: change accepted.
```

```
WX1200# set authentication dot1x ssid mycorp *.mycorp.com
bonded pass-through radgrp1
success: change accepted.
```

The following command sets the Bonded Auth period to 60 seconds, to allow time for WEP users to reauthenticate:

```
WX1200# set dot1x bonded-period 60
success: change accepted.
```

Displaying Bonded Auth Configuration Information

To display Bonded Auth configuration information, use the following command:

```
display dot1x config
```

In the following example, bob.mycorp.com uses Bonded Auth, and the Bonded Auth period is set to 60 seconds.

```
WX1200# display dot1x config

                    802.1X user policy
                  ----------------------
 'host/bob-laptop.mycorp.com' on ssid 'mycorp' doing PASSTHRU
 'bob.mycorp.com' on ssid 'mycorp' doing PASSTHRU (bonded)
        802.1X parameter                setting
        ----------------                -------
        supplicant timeout              30
        auth-server timeout             30
        quiet period                    60
        transmit period                 5
        reauthentication period         3600
        maximum requests                2
        key transmission                enabled
        reauthentication                enabled
        authentication control          enabled
        WEP rekey period                1800
        WEP rekey                       enabled
        Bonded period                   60
```

Information for the 802.1X authentication rule for the machine (host/bob-laptop.mycorp.com) is also displayed. However, the **bonded** option is configured only for the user authentication rule. The **bonded** option applies only to the authentication rules for users, not the authentication rules for machines.

Configuring Authentication and Authorization by MAC Address

You must sometimes authenticate users based on the MAC addresses of their devices rather than a username-password or certificate. For example, some Voice-over-IP (VoIP) phones and personal digital assistants (PDAs) do not support 802.1X authentication. If a client does not support 802.1X, MSS attempts to perform MAC authentication for the client instead. The WX switch can discover the MAC address of the device from received frames and can use the MAC address in place of a username for the client.

Users authorized by MAC address require a MAC authorization password if RADIUS authentication is desired. By default, MSS assumes that the MAC address for a MAC user is also the password.

⚠ ***CAUTION:*** *Use this method with care. IEEE 802.11 frames can be forged and can result in unauthorized network access if MAC authentication is employed.*

Adding and Clearing MAC Users and User Groups Locally

MAC users and groups can gain network access only *through* the WX switch. They cannot create administrative connections *to* the WX switch. A MAC user is created in a similar fashion to other local users except for having a MAC address instead of a username. MAC user groups are created in a similar fashion to other local user groups.

(To create a MAC user profile or MAC user group on a RADIUS server, see the documentation for your RADIUS server.)

Adding MAC Users and Groups

To create a MAC user group in the local WX database, you must associate it with an authorization attribute and value. Use the following command:

```
set mac-usergroup group-name attr attribute-name value
```

For example, to create a MAC user group called *mac-easters* with a 3000-second Session-Timeout value, type the following command:

```
WX1200# set mac-usergroup mac-easters attr
session-timeout 3000
success: change accepted.
```

To configure a MAC user in the local database and optionally add the user to a group, use the following command:

```
set mac-user mac-addr [group group-name]
```

For example, type the following command to add MAC user 01:0f:03:04:05:06 to group *macfans:*

```
WX1200# set mac-user 01:0f:03:04:05:06 group macfans
success: change accepted.
```

Clearing MAC Users and Groups

To clear a MAC user from a user group, use the following command:

```
clear mac-user mac-addr group
```

For example, the following command removes MAC user 01:0f:03:04:05:06 from group *macfans:*

```
WX1200# clear mac-user 01:0f:03:04:05:06 group
success: change accepted.
```

The **clear mac-usergroup** command removes the group.

To remove a MAC user profile from the local database on the WX switch, type the following command:

```
clear mac-user mac-address
```

For example, the following command removes MAC user 01:0f:03:04:05:06 from the local database:

```
WX1200# clear mac-user 01:0f:03:04:05:06
success: change accepted.
```

Configuring MAC Authentication and Authorization

The **set authentication mac** command defines the AAA methods by which MAC addresses can be used for authentication. You can configure authentication for users through the MAC addresses of their devices with the following command:

```
set authentication mac {ssid ssid-name | wired} mac-addr-glob
method1 [method2] [method3] [method4]
```

MAC addresses can be authenticated by either the WX local database or by a RADIUS server group. For example, the following command sets the authentication for MAC address 01:01:02:03:04:05 when requesting SSID *voice*, via the local database:

```
WX1200# set authentication mac ssid voice
01:01:02:03:04:05 local
success: change accepted
```

If the switch's configuration does not contain a **set authentication mac** command that matches a non-802.1X client's MAC address, MSS tries MAC authentication by default.

You can also glob MAC addresses. For example, the following command locally authenticates all MAC addresses that begin with the octets 01:01:02:

```
WX1200# set authentication mac ssid voice 01:01:02:* local
success: change accepted
```

(For details about MAC address globs, see "MAC Address Globs" on page 31.)

You can add authorization attributes to authenticated MAC users with the following command:

```
set mac-user mac-addr attr attribute-name value
```

For example, to add the MAC user 00:01:02:03:04:05 to VLAN *red*:

```
WX1200# set mac-user 00:01:02:03:04:05 attr vlan-name red
success: change accepted
```

To change the value of an authorization attribute, reenter the command with the new value. To clear an authorization attribute from a MAC user profile in the local database, use the following command:

```
clear mac-user mac-addr attr attribute-name
```

For example, the following command clears the VLAN assignment from MAC user 01:0f:02:03:04:05:

```
WX1200# clear mac-user 01:0f:03:04:05:06 attr vlan-name
success: change accepted.
```

(For a complete list of authorization attributes, see Table 43 on page 488.)

Changing the MAC Authorization Password for RADIUS

When you enable MAC authentication, the client does not supply a regular username or password. The MAC address of the user's device is extracted from frames received from the device.

To authenticate and authorize MAC users via RADIUS, MSS must supply a password for MAC users, which is called the outbound authorization password. By default, MSS sends the MAC user's MAC address as that user's password too.

To set the authorization password to a specific value for all MAC users, use the following command:

```
set radius server server-name author-password password
```

Before setting the outbound authorization password for a RADIUS server, you must have set the address for the RADIUS server. For more information, see "Configuring RADIUS Servers" on page 521.

For example, the following command sets the outbound authorization password for MAC users on server *bigbird* to *h00per*:

```
WX1200# set radius server bigbird author-password h00per
success: change accepted.
```

If the MAC address is in the database, MSS uses the VLAN attribute and other attributes associated with it for user authorization. Otherwise, MSS tries the fallthru authentication type, which can be last-resort, Web, or none.

A MAC address must be dash-delimited in the RADIUS database — for example, 00-00-01-03-04-05. However, the MSS always displays colon-delimited MAC addresses.

To reset the authorization password to the default (user's MAC address), clear the RADIUS server, then readd it without specifying the authorization password. To clear a RADIUS server, use the **clear radius server** *server-name* command.

Configuring Web Portal WebAAA

WebAAA simplifies secure access to unencrypted SSIDs. When a user requests access to an SSID or attempts to access a web page before logging onto the network, MSS serves a login page to the user's browser. After the user enters a username and password, MSS checks the local database or RADIUS servers for the user information, and grants or denies access based on whether the user information is found.

MSS redirects an authenticated user back to the requested web page, or to a page specified by the administrator.

WebAAA, like other types of authentication, is based on an SSID or on a wired authentication port.

You can use WebAAA on both encrypted and unencrypted SSIDs. If you use WebAAA on an encrypted SSID, you can use static WEP or WPA with PSK as the encryption type.

MSS provides a 3Com login page, which is used by default. You can add custom login pages to the WX switch's nonvolatile storage, and configure MSS to serve those pages instead.

Web Portal WebAAA replaces the WebAAA implementation in MSS Version 3.x. The previous implementation is deprecated beginning in MSS Version 4.0. During upgrade from MSS Version 3.x, your 3.x WebAAA configuration is automatically converted to a Web Portal WebAAA configuration.

How WebAAA Portal Works

1. A WebAAA user attempts to access the network. For a wireless user, this begins when the user's network interface card (NIC) associates with an SSID on a 3Com radio. For a wired authentication user, this begins when the user's NIC sends data on the wired authentication port.

2. MSS starts a portal session for the user, and places the user in a VLAN.
   - If the user is wireless (associated with an SSID), MSS assigns the user to the VLAN set by the vlan-name attribute for the SSID's service profile.
   - If the user is on a wired authentication port, the VLAN is the one assigned to the *web-portal-wired* user.

3 The user opens a Web browser. The Web browser sends a DNS request for the IP address of the home page or a URL requested by the user.

4 MSS does the following:

- Intercepts the DNS request, uses the MSS DNS proxy to obtain the URL IP address from the network DNS server, and sends the address to the user's browser.
- Serves a login page to the WebAAA user. (Also see "Display of the Login Page" on page 461.)

5 The user enters their username and password in the WebAAA login page.

6 MSS authenticates the user by checking RADIUS or the switch's local database for the username and password entered by the user. If the user information is present, MSS authorizes the user based on the authorization attributes set for the user.

MSS ignores the VLAN-Name or Tunnel-Private-Group-ID attribute associated with the user, and leaves the user in the VLAN associated with the SSID's service profile (if wireless) or with the web-portal-wired user (if the user is on a wired authentication port).

7 After authentication and authorization are complete, MSS changes the user's session from a portal session with the name **web-portal-*ssid*** or **web-portal-wired** to a WebAAA session with the user's name. The session remains connected, but is now an identity-based session for the user instead of a portal session.

8 MSS redirects the browser to the URL initially requested by the user or, if the URL VSA is configured for the user, redirects the user to the URL specified by the VSA.

9 The web page for the URL to which the user is redirected appears in the user's browser window.

Display of the Login Page

When a WebAAA client first tries to access a web page, the client's browser sends a DNS request to obtain the IP address mapped to the domain name requested by the client's browser. The WX proxies this DNS request to the network's DNS server, then proxies the reply back to the client. If the DNS server has a record for the requested URL, the request is successful and the WX serves a web login page to the client. However, if the DNS request is unsuccessful, the WX displays a message informing the user of this and does not serve the login page.

If the WX does not receive a reply to a client's DNS request, the WX spoofs a reply to the browser by sending the WX switch's own IP address as the resolution to the browser's DNS query. The WX also serves the web login page. This behavior simplifies use of the WebAAA feature in networks that do not have a DNS server. However, if the requested URL is invalid, the behavior gives the appearance that the requested URL is valid, since the browser receives a login page. Moreover, the browser might cache a mapping of the invalid URL to the WX IP address.

If the user enters an IP address, most browsers attempt to contact the IP address directly without using DNS. Some browsers even interpret numeric strings as IP addresses (in decimal notation) if a valid address could be formed by adding dots (dotted decimal notation). For example, 208194225132 would be interpreted as a valid IP address, when converted to 208.194.225.132.

WebAAA Requirements and Recommendations

Use the following information to ensure operation of the WebAAA feature.

MSS Version 5.0 does not require or support special user web-portal-ssid, where ssid is the SSID the Web-Portal user associates with. Previous MSS Versions required this special user for Web-Portal configurations. Any web-portal-ssid users are removed from the configuration during upgrade to MSS Version 5.0. However, the web-portal-wired user is still required for Web Portal on wired authentication ports.

WX Switch Requirements

- WebAAA certificate—A WebAAA certificate must be installed on the switch. You can use a self-signed (signed by the WX) WebAAA certificate automatically generated by MSS, manually generate a self-signed one, or install one signed by a trusted third-party certificate authority (CA). (For more information, see Chapter 20, "Managing Keys and Certificates," on page 413.)
- If you choose to install a self-signed WebAAA certificate, use a common name (a required field in the certificate), that resembles a web address and contains at least one dot. When MSS serves the login page to the browser, the page's URL is based on the common name in the WebAAA certificate.

Here are some examples of common names in the recommended format:

- webaaa.login
- webaaa.customername.com
- portal.local

Here are some examples of common names that are not in the recommended format:

- webaaa
- 3Com_webaaa
- webportal

- User VLAN—An IP interface must be configured on the user's VLAN. The interface must be in the subnet on which the DHCP server will place the user, so that the switch can communicate with both the client and the client's preferred DNS server. (To configure a VLAN, see "Configuring and Managing VLANs" on page 87.)

  If users will roam from the switch where they connect to the network to other WX switches, the system IP addresses of the switches should not be in the web-portal VLAN.

  Although the SSID's default VLAN and the user VLAN must be the same, you can use a location policy on the switch where the service profile is configured to move the user to another VLAN. The other VLAN is not required to be statically configured on the switch. The VLAN does have the same requirements as other user VLANs, as described above. For example, the user VLAN on the roamed-to switch must have an IP interface, the interface must be in the subnet that has DHCP, and the subnet must be the same one the DHCP server will place the user in.

In MSS Version 4.1 and earlier, the VLAN was required to be statically configured on the WX switch where WebAAA was configured and through which the user accessed the network. MSS Version 4.2 removes this restriction. The VLAN you want to place an authenticated WebAAA user on does not need to be statically configured on the switch where Web Portal is configured. If the VLAN you assign to a user is not statically configured on the VLAN where the user accesses the network, the switch where the user accessed the network builds a tunnel to the switch where the user's VLAN is configured. That switch uses DHCP to assign an IP address to the user.

- Fallthru authentication type—The fallthru authentication type for each SSID and wired authentication port that you want to support WebAAA, must be set to **web-portal**. The default authentication type for wired authentication ports and for SSIDs is None (no fallthru authentication is used).

To set the fallthru authentication type for an SSID, set it in the service profile for the SSID, using the **set service-profile auth-fallthru** command. To set it on a wired authentication port, use the **auth-fall-thru web-portal** parameter of the **set port type wired-auth** command.

- Authorization attributes—Wireless Web-Portal users get their authorization attributes from the SSID's service profile. To assign wireless Web-Portal users to a VLAN, use the set **service-profile *name* attr vlan-name *vlan-id*** command.

  Web-Portal users on wired authentication ports get their authorization attributes from the special user **web-portal-wired**. To assign wired Web-Portal users to a VLAN, use the **set user web-portal-wired attr vlan-name *vlan-id*** command. By default, **web-portal-wired** users are assigned to the default VLAN.

- Portal ACL (created by MSS automatically)—The *portalacl* ACL captures all the portal user's traffic except for DHCP traffic. The *portalacl* has the following ACEs:

```
set security acl ip portalacl permit udp 0.0.0.0
255.255.255.255 eq 68 0.0.0.0 255.255.255.255 eq 67
set security acl ip portalacl deny 0.0.0.0 255.255.255.255
capture
```

MSS automatically creates the *portalacl* ACL the first time you set the fallthru authentication type on any service profile or wired authentication port to **web-portal**.

- The ACL is mapped to wireless Web-Portal users through the service profile. When you set the fallthru authentication type on a service profile to web-portal, portalacl is set as the Web-Portal ACL. The ACL is applied to a Web-Portal user's traffic when the user associates with the service profile's SSID.
- The ACL is mapped to Web-Portal users on a wired-authentication port by the Filter-id.in attribute configured on the web-portal-wired user. When you set the fallthru authentication type on a wired authentication port to web-portal, MSS creates the web-portal-wired user. MSS sets the filter-id attribute on the user to portalacl.in.

***CAUTION:** Without the Web-Portal ACL, WebAAA users will be placed on the network without any filters.*

***CAUTION:** Do not change the deny rule at the bottom of the ACL. This rule must be present and the **capture** option must be used with the rule. If the rule does not have the capture option, the Web Portal user never receives a login page. If you need to modify the Web-Portal ACL, create a new one instead, and modify the service profile or web-portal-wired user to use the new ACL.*

- Authentication rules—A web authentication rule must be configured for the WebAAA users. The web rule must match on the username the WebAAA user will enter on the WebAAA login page. (The match can be on a userglob or individual username.) The web rule also must match on the SSID the user will use to access the network. If the user will access the network on a wired authentication port, the rule must match on **wired**.

  To configure authentication rules, use the **set authentication web** command.

- Web Portal WebAAA must be enabled, using the **set web-portal** command. The feature is enabled by default.

Portal ACL and User ACLs

The *portalacl* ACL, which MSS creates automatically, applies only when a user's session is in the portal state. After the user is authenticated and authorized, the ACL is no longer applicable.

To modify a user's access while the user is still being authenticated and authorized, you can configure another ACL and map that ACL instead to the **web-portal-*ssid*** or **web-portal-wired** user. Make sure to use the **capture** option for traffic you do not want to allow. 3Com recommends that you do not change the *portalacl* ACL. Leave the ACL as a backup in case you need to refer to it or you need to use it again.

For example, if you want to allow the user to access a credit card server while MSS is still authenticating and authorizing the user, create a new ACL, add ACEs that are the same as the ACEs in *portalacl*, and add a new ACE before the last one, to allow access to the credit card server. Make sure the last ACE in the ACL is the deny ACE that captures all traffic that is not allowed by the other ACEs.

To modify a WebAAA user's access after the user is authenticated and authorized, map an ACL to the individual WebAAA user. Changes you make to the ACL mapped to the **web-portal-*ssid*** or **web-portal-wired** user do not affect user access after authentication and authorization are complete.

*The **filter-id** attribute in a service profile applies only to authenticated users. If this attribute is set in a service profile for an SSID accessed by Web-Portal users, the attribute applies only after users have been authenticated. While a Web-Portal user is still being authenticated, the ACL set by the **web-portal-acl** applies instead.*

Network Requirements

The VLAN where users will be placed must have an IP interface, and the subnet the interface is in must have access to DHCP and DNS servers.

WX Switch Recommendations

- Consider installing a WebAAA certificate signed by a trusted CA, instead of one signed by the WX switch itself. Unless the client's browser is configured to trust the signature on the switch's WebAAA certificate, display of the login page can take several seconds longer than usual, and might be interrupted by a dialog asking the user what to do about the untrusted certificate. Generally, the browser is already configured to trust certificates signed by a CA.

Client NIC Requirements

- Configure the NIC to use DHCP to obtain its IP address.

Client Web Browser Recommendations

- Use a well-known browser, such as Internet Explorer (Windows), Firefox (Mozilla-based), or Safari (Macintosh)
- If the WebAAA certificate on the WX switch is self-signed, configure the browser to trust the signature by installing the certificate on the browser, so that the browser does not display a dialog about the certificate each time the user tries to log on.

Configuring Web Portal WebAAA

To configure Web Portal WebAAA:

1. Configure an SSID or wired authentication port and set the fallthru authentication type to **web-portal**. The default for SSIDs and for wired authentication ports is **none**.

2. Configure individual WebAAA users. Because the VLAN is assigned based on the service profile (where it is set by the attr **vlan-name** *vlan-id* option) or **web-portal-wired** user (where it is set to *default*), MSS ignores the VLAN-Name and Tunnel-Private-Group-ID attributes. However, MSS does assign other attributes if set.
3. Configure web authentication rules for the WebAAA users.
4. Save the configuration changes.

Web Portal WebAAA Configuration Example

This example configures Web-Portal access to SSID *mycorp*.

1. Configure the user VLAN on ports 2 and 3, and configure an IP interface on the VLAN:

```
WX1200# set vlan mycorp-vlan port 2-3
success: change accepted.
WX1200# set interface mycorp-vlan ip 192.168.12.10
255.255.255.0
success: change accepted.
```

The VLAN does not need to be configured on the switch where you configure Web Portal but the VLAN does need to be configured on a switch somewhere in the Mobility Domain. The user's traffic will be tunneled to the switch where the VLAN is configured.

2. Configure the service profile for SSID *mycorp*. Configuration includes the following:

- Set the SSID name.
- Change the fallthru authentication type to **web-portal**.
- Set the default VLAN to *mycorp-vlan* (created in step 1.) MSS will place Web-Portal users into this VLAN.
- Enable RSN (WPA2) data encryption with CCMP. (This example assumes clients support this encryption type.) TKIP is enabled by default and is left enabled in this example.

```
WX1200# set service-profile mycorp-srvcprof ssid-name mycorp
success: change accepted.
```

```
WX1200# set service-profile mycorp-srvcprof auth-fallthru
web-portal
success: change accepted.
WX1200# set service-profile mycorp-srvcprof attr vlan-name
mycorp-vlan
success: change accepted.
WX1200# set service-profile mycorp-srvcprof rsn-ie enable
success: change accepted.
WX1200# set service-profile mycorp-srvcprof cipher-ccmp
enable
success: change accepted.
```

3 Display the service profile to verify the changes:

```
WX1200# display service-profile mycorp-srvcprof
ssid-name:                          mycorp   ssid-type:                  crypto
Beacon:                                yes   Proxy ARP:                      no
DHCP restrict:                          no   No broadcast:                   no
Short retry limit:                       5   Long retry limit:                5
Auth fallthru:                        none   Sygate On-Demand (SODA):        no
Enforce SODA checks:                   yes   SODA remediation ACL:
Custom success web-page:                     Custom failure web-page:
Custom logout web-page:                      Custom agent-directory:
Static COS:                             no   COS:                             0
CAC mode:                             none   CAC sessions:                   14
User idle timeout:                     180   Idle client probing:           yes
Keep initial vlan:                      no   Web Portal Session Timeout:      5
Web Portal ACL:                  portalacl
WEP Key 1 value:                    <none>   WEP Key 2 value:            <none>
WEP Key 3 value:                    <none>   WEP Key 4 value:            <none>
WEP Unicast Index:                       1   WEP Multicast Index:             1
Shared Key Auth:                        NO
RSN enabled:
    ciphers: cipher-tkip, cipher-ccmp
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
vlan-name = mycorp-vlan
                              ...
```

4 Configure individual WebAAA users.

```
WX1200# set user alice password alicepword
success: change accepted.
WX1200# set user bob password bobpword
success: change accepted.
```

5 Configure a web authentication rule for WebAAA users. The following rule uses a wildcard (**) to match on all user names.

The rule does not by itself allow access to all usernames. The ** value simply makes all usernames eligible for authentication, in this case by searching the switch's local database for the matching usernames and passwords. If a username does not match on the access rule's userglob, the user is denied access without a search of the local database for the username and password.

```
WX4400# set authentication web ssid mycorp ** local
success: change accepted.
```

6 Display the configuration:

```
WX1200# display config
# Configuration nvgen'd at 2006-6-13 13:27:07
# Image 5.0.0.0.62
# Model WXR100-2
# Last change occurred at 2006-6-13 13:24:46
...
set service-profile mycorp-srvcprof ssid-name mycorp
set service-profile mycorp-srvcprof auth-fallthru web-portal
set service-profile mycorp-srvcprof rsn-ie enable
set service-profile mycorp-srvcprof cipher-ccmp enable
set service-profile mycorp-srvcprof web-portal-acl portalacl
set service-profile mycorp-srvcprof attr vlan-name
mycorp-vlan
...
set authentication web ssid mycorp ** local
...
set user alice password encrypted 070e2d454d0c091218000f
set user bob password encrypted 110b16070705041e00
...
set radio-profile radprof1 service-profile mycorp-srvcprof
set ap 7 radio 2 radio-profile radprof1 mode enable
set ap 8 radio 2 radio-profile radprof1 mode enable
...
set vlan corpvlan port 2-3
set interface corpvlan ip 192.168.12.10 255.255.255.0
...
set security acl ip portalacl permit udp 0.0.0.0
255.255.255.255 eq 68 0.0.0.0 255.255.255.255 eq 67
set security acl ip portalacl deny 0.0.0.0 255.255.255.255
capture
commit security acl portalacl
```

Displaying Session Information for Web Portal WebAAA Users

To display user session information for Web Portal WebAAA users, use the following command:

display sessions network [**user** *user-glob* | **mac-addr** *mac-addr-glob* | **ssid** *ssid-name* | **vlan** *vlan-glob* | **session-id** *session-id* | **wired**] [**verbose**]

You can determine whether a Web Portal WebAAA user has completed the authentication and authorization process, based on the username displayed in the session table. The following command shows the sessions for SSID *mycorp*.

```
WX4400# display sessions network ssid mycorp
User                           Sess  IP or MAC          VLAN            Port/
Name                             ID  Address            Name            Radio
------------------------------ ----  ------------------ --------------- -----
alice                            4* 192.168.12.101    corpvlan          3/1
web-portal-mycorp                5  192.168.12.102    corpvlan          3/1
2 sessions total
```

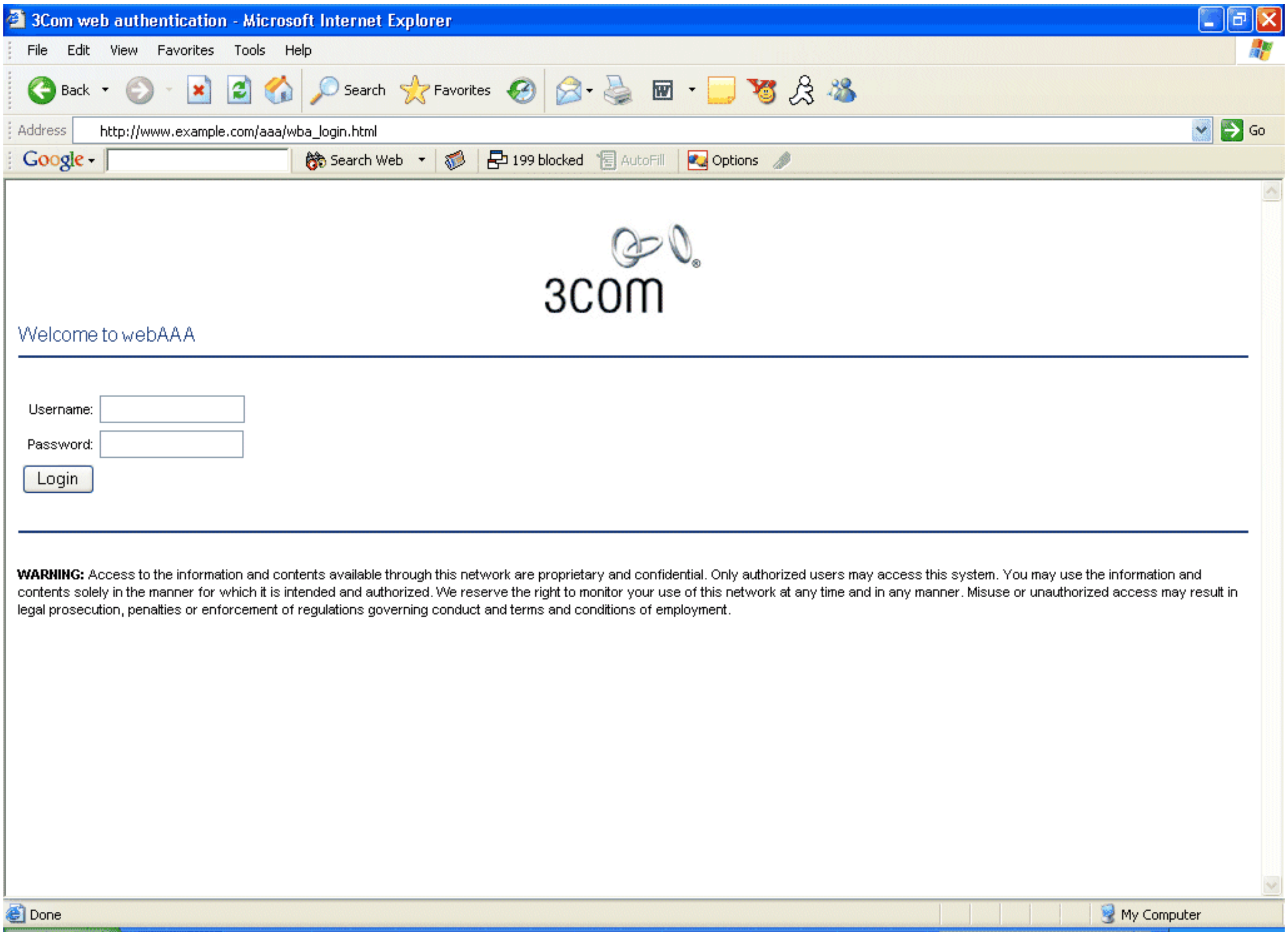
This example shows two sessions. The session for *alice* has the user's name and is flagged with an asterisk (*). The asterisk indicates that the user has completed authentication and authorization. The session for *web-portal-mycorp* indicates that a WebAAA user is on the network but is still being authenticated. The user *alice* has all the access privileges configured for the user, whereas the user who is still on the portal session with the name *web-portal-mycorp* has limited access to resources. By default, this user can send and receive DHCP traffic only. Everything else is captured by the web portal.

After authentication and authorization are complete, the *web-portal-mycorp* username is replaced with the username entered by the WebAAA user during login. The following example shows session information for the same user, but after the user is authorized to access resources on the network:

```
WX4400# display sessions network ssid mycorp
User                           Sess  IP or MAC          VLAN            Port/
Name                             ID  Address            Name            Radio
------------------------------ ----  ------------------ --------------- -----
alice                            4* 192.168.12.101    corpvlan          3/1
bob                              5* 192.168.12.102    corpvlan          3/1
2 sessions total
```

Using a Custom Login Page

By default, MSS serves the 3Com login page for Web login.


3Com web authentication - Microsoft Internet Explorer
File
Edit
View
Favorites
Tools
Help
Back
Search
Favorites
Address
Go
Google
Search Web
199 blocked
AutoFill
Options
3com
Username:
Password:
Login
Done
My Computer

http://www.example.com/aaa/wba_login.html

Welcome to webAAA

WARNING: Access to the information and contents available through this network are proprietary and confidential. Only authorized users may access this system. You may use the information and contents solely in the manner for which it is intended and authorized. We reserve the right to monitor your use of this network at any time and in any manner. Misuse or unauthorized access may result in legal prosecution, penalties or enforcement of regulations governing conduct and terms and conditions of employment.

To serve a custom page instead, do the following:

1. Copy and modify the 3Com page, or create a new page.
2. Create a subdirectory in the user files area of the WX switch's nonvolatile storage, and copy the custom page into the subdirectory.
3. Configure SSIDs and wired authentication ports to use the custom form, by specifying the location of the form.

To serve a custom login page to wired authentication users, you must create a web subdirectory and save the custom page in this directory.

MSS uses the following process to find the login page to display to a user:

- If the user is attempting to access an SSID and a custom page is specified in the service profile, MSS serves the custom page.
- If the switch nonvolatile storage has a page in *web* named *wba_form.html* (*web/wba_form.html*), MSS serves this page. This applies to all wired authentication users. The *wba_form.html* page also is served to SSID users if the SSID service profile does not specify a custom page.
- If there is no *wba_form.html* page and no custom page in the SSID service profile, MSS serves the default page.

Copying and Modifying the Web Login Page

To copy and modify the 3Com Web login page:

1. Configure an unencrypted SSID on a WX switch. The SSID is temporary and does not need to be one you intend to use in your network. To configure the SSID, use the following commands:

```
set service-profile name ssid-name ssid-name
set service-profile name ssid-type clear
set service-profile name auth-fallthru web-portal
set radio-profile name service-profile name
set ap apnumber radio {1 | 2} radio-profile name mode enable
```

   Use the first two commands to configure a temporary SSID and temporary radio profile. Use the last command to map the temporary radio profile with the disabled radio, and enable the radio.

   If the radio you plan to use is already in service, you need to disable the radio profile the radio is in and remove the radio from the profile.

2. From your PC, attempt to access the temporary SSID. The WX switch should serve the login page.
3. Use your browser to save a copy of the page.
4. Use a Web page editor or text editor to modify the page title, greeting, logo, and warning text. Be sure that the <form> HTML tag has the following format: <form name=”weblogin” method=”post” action=””>.

   Earlier versions of MSS present a page using the form tag. More recent versions of MSS automatically populate the action parameter with an HTTPS URL in order to defer the SSL transaction to the actual posting of the form. This URL must be removed from the action parameter in your custom page so that the format matches the <form name=”weblogin” method=”post” action=””> format exactly.

5 Save the modified page.

Filenames and paths for image source files must be relative to the HTML page. For example, if login page mycorp-login.html and image file mylogo.gif are located in subdirectory mycorp/, specify the image source as mylogo.gif, not mycorp/mylogo.gif.

It is recommended to keep the form as simple as possible with a minimum number of graphics to display.

Custom Login Page Scenario

The following steps illustrate how to create a custom page:

1 Perform following on the WX switch:

  a Create a temporary service profile and configure a temporary, clear SSID on it:

```
WX1200# set service-profile tempsrvc ssid-name tempssid
success: change accepted.
WX1200# set service-profile tempsrvc ssid-type clear
success: change accepted.
WX1200# set service-profile tempsrvc auth-fallthru web-portal
success: change accepted.
```

  b Create a temporary radio profile and map the temporary service profile to it:

```
WX1200# set radio-profile temprad service-profile tempsrvc
success: change accepted.
```

  c Map a radio to the temporary radio profile and enable it:

```
WX1200# set ap 2 radio 1 radio-profile temprad mode enable
success: change accepted.
```

2 From your PC, attempt to access the temporary SSID. The WX switch displays the login page.

3 In the browser, select **File > Save As** to save the login page.

4 Edit the login page:

  a Change the page title:

```
<TITLE>My Corp webAAA</TITLE>
```

  b Change the logo:

```
<img src="mylogo.gif" width="143" height="65" border="0"
alt="Company Logo">
```

c Change the greeting:

```
<h3>Welcome to Mycorp's Wireless LAN</h3>
```

d Change the warning statement if desired:

```
<B>WARNING:</B>
My corp's warning text.
```

e Do not change the form (delimited by the <form name=> and </form> tags. The form values are required for the page to work properly.

3Com recommends using an HTML editor that preserves the original HTML code rather than reformatting the entire document. If the section of the page between <!-- DO_NOT_MODIFY_THE_SOURCE_BEGIN --> and <!--END DO_NOT_MODIFY_THE_SOURCE--> is modified manually or by your HTML editing application, the page should be thoroughly tested prior to deploying it on your network and after every MSS software upgrade.

5 Save the modified page.

6 On the WX switch, create a new subdirectory for the customized page. (The files must be on a TFTP server that the WX switch can reach over the network.)

```
WX1200# mkdir mycorp-webaaa
success: change accepted.
```

7 Copy the files for the customized page into the subdirectory:

```
WX1200# copy tftp://10.1.1.1/mycorp-login.html mycorp-webaaa/mycorp-login.html
success: received 637 bytes in 0.253 seconds [ 2517 bytes/sec]
WX1200# copy tftp://10.1.1.1/mylogo.gif mycorp-webaaa/mylogo.gif
success: received 1202 bytes in 0.402 seconds [ 2112 bytes/sec]

WX1200# dir mycorp-webaaa
===============================================================================
file:
Filename                                   Size           Created
file:mycorp-login.html                     637 bytes   Aug 12 2004, 15:42:26
file:mylogo.gif                           1202 bytes   Aug 12 2004, 15:57:11
Total:        1839 bytes used, 206577 Kbytes free
```

8 Use the following command to configure the SSID to use the custom page:

```
set service-profile name web-portal-form url
```

For the *url*, specify the full path; for example, *mycorp-webaaa/mycorp-login.html*. If the custom login page includes *.gif or *.jpg images, their path names are interpreted relative to the directory from which the page is served.

9 Configure WebAAA users and rules as described in "Configuring Web Portal WebAAA" on page 460.

Using Dynamic Fields in WebAAA Redirect URLs

You can include variables in the URL to which a WebAAA client is redirected after authentication and authorization. Table 41 lists the variables you can include in a redirect URL.

Table 41 Variables for Redirect URLs

Variable	Description
$u	Username of the WebAAA user
$v	VLAN to which the user was assigned during authorization
$s	SSID the user is on
$p	Name of the service profile that manages the parameters for the SSID

A URL string can also contain the literal characters $ and ?, if you use the values listed in Table 42.

Table 42 Values for Literal Characters

Variable	Description
$$	The literal character $
$q	The literal character ?

You can configure a redirect URL for a group of users or for an individual user. For example, the following command configures a redirect URL containing a variable for the username:

```
WX1200# set usergroup ancestors attr url http://myserver.com/$u.html
success: change accepted.
```

The variable applies to all WebAAA users in user group *ancestors*. When user *zinjanthropus* is successfully authenticated and authorized, MSS redirects the user to the following URL:

http://myserver.com/zinjanthropus.html

When user *piltdown* is successfully authenticated and authorized, MSS redirects the user to the following URL:

http://myserver.com/piltdown.html

The following example configures a redirect URL that contains a script argument using the literal character *?*:

```
WX1200# set usergroup ancestors attr url https://saqqara.org/login.php$quser=$u
success: change accepted.
```

When user *djoser* is successfully authenticated and authorized, MSS redirects the user to the following URL:

https://saqqara.org/login.php?user=djoser

To verify configuration of a redirect URL and other user attributes, type the **display aaa** command.

Using an ACL Other Than *portalacl*

By default, when you set the fallthru authentication type on a service profile or wired authentication port to **web-portal**, MSS creates an ACL called *portalacl*. MSS uses the *portalacl* ACL to filter Web-Portal user traffic while users are being authenticated.

To use another ACL:

1. Create a new ACL and add the first rule contained in *portalacl*:

   ```
   set security acl ip portalacl permit udp 0.0.0.0
   255.255.255.255 eq 68 0.0.0.0 255.255.255.255 eq 67
   set security acl ip portalacl deny 0.0.0.0 255.255.255.255
   capture
   ```

2. Add the additional rules required for your application. For example, if you want to redirect users to a credit card server, add the ACEs to do so.
3. Add the last rule contained in *portalacl*:

   ```
   set security acl ip portalacl deny 0.0.0.0 255.255.255.255
   capture
   ```

4. Verify the new ACL configuration, before committing it to the configuration, using the following command:

   ```
   display security acl info [acl-name | all] [editbuffer]
   ```

5 Commit the new ACL to the configuration, using the following command:

```
commit security acl
```

6 Change the Web-Portal ACL name set on the service profile, using the following command:

```
set service-profile name web-portal-acl aclname
```

7 Verify the change by displaying the service profile.

8 Save the configuration changes.

Configuring the Web Portal WebAAA Session Timeout Period

When a client that has connected through Web Portal WebAAA enters standby or hibernation mode, MSS may place the client's Web Portal WebAAA session in the *Deassociated* state.

A Web Portal WebAAA session can be placed in the Deassociated state under the following circumstances:

- The client has been idle for the User idle-timeout period, which can happen when the client is in standby or hibernation mode
- The client explicitly deassociates from the MAP by sending an 802.11 disassociate message
- The MAP handling the client's session appears to be inoperative from the WX switch

When a Web Portal WebAAA session enters the Deassociated state, it stays in that state until one of the following takes place:

- The client reappears on this MAP or another MAP managed by a WX switch, at which time the Web Portal WebAAA session enters the Active state
- The Web Portal WebAAA session is terminated administratively
- The *Web Portal WebAAA session timeout period* expires, at which time the Web Portal WebAAA session is terminated automatically

By default, the Web Portal WebAAA session timeout period is 5 seconds. You can optionally change the length of the Web Portal WebAAA Session Timeout period. This can be useful if you want to allow a client connecting through Web Portal WebAAA to enter standby or hibernation mode, then be able to resume its session after waking up, without having to log in again.

To change the Web Portal WebAAA session timeout period, use the following command:

```
set service-profile name web-portal-session-timeout seconds
```

You can specify from 5 – 2,800 seconds. The default is 5 seconds. Note that the Web Portal WebAAA session timeout period applies only to Web Portal WebAAA sessions already authenticated with a username and password. For all other Web Portal WebAAA sessions, the default Web Portal WebAAA session timeout period of 5 seconds is used.

Configuring the Web Portal Logout Function

You can configure Web Portal WebAAA to allow a user to manually terminate his or her session. When this feature is enabled, after a Web Portal WebAAA user is successfully authenticated and redirected to the requested page, a pop-under window appears behind the user's browser. The window contains a button labeled "End Session". When the user clicks this button, a URL is requested that terminates the user session in the Mobility Domain.

The user's logout request is sent to one of the WX switches in the Mobility Domain. It does not have to be the WX that the user was authenticated on, or the WX where the user session currently resides. The WX receiving the logout request determines which WX switch has the user session. If it is a local session, the session is terminated. If another WX switch in the Mobility Domain has the session, then it redirects the request to that WX.

This feature is useful for allowing Web Portal users a way to manually log out of the network, instead of waiting to be logged out automatically when the Web Portal WebAAA session timeout period expires.

To enable the Web Portal logout functionality, use the following command:

```
set service-profile profile-name web-portal-logout mode
{enable | disable}
```

To specify a Web Portal logout URL, use the following command:

```
set service-profile profile-name web-portal-logout
logout-url url
```

The URL should be of the form **https://***host***/logout.html**. By default, the logout URL uses the IP address of the WX switch as the *host* part of the URL. The *host* can be either an IP address or a hostname.

Specifying the logout URL is useful if you want to standardize it across your network. For example, you can configure the logout URL on all of the WX switches in the Mobility Domain as *wifizone.3com.com/logout.html*, where *wifizone.3com.com* resolves to one of the WX switches in the Mobility Domain, ideally the seed.

To log out of the network, the user can click the "End Session" button in the pop-under window, or request the logout URL directly.

Standardizing the logout URL serves as a backup means for the user to log out in case the pop-under window is closed inadvertently. Note that if a user requests the logout URL, he or she must enter a username and password in order to identify the session on the WX. (This is not necessary when the user clicks the "End Session" button in the pop-under window.) Both the username and password are required to identify the session. If there is more than one session with the same username, then requesting the logout URL does not end any session.

Also note that an adminstrative certificate must be configured on the WX switches in order for the Web Portal WebAAA logout process to work.

Configuring Last-Resort Access

Users who are not authenticated and authorized by 802.1X methods or a MAC address can gain limited access to the network as guest users. You can configure an SSID to allow anonymous guest access, by setting its fallthru authentication type to **last-resort**. The authorization attributes assigned to last-resort users come from the default authorization attributes set on the SSID.

To configure an SSID to allow last-resort access:

- Set the SSID name, if not already set.
- Set the fallthru access type of the SSID's service profile to last-resort.
- Set the vlan-name and other authorization attributes on the SSID's service profile.
- If the SSID type will be **crypto** (the default), configure encryption settings.

You do not need to configure an access rule for last-resort access. Last-resort access is automatically enabled on all service profiles and wired authentication ports that have the fallthru authentication type set to **last-resort**. (The **set authentication last-resort** and **clear authentication last-resort** commands are not needed and are not supported in MSS Version 5.0 and later.)

The authentication method for last-resort is always local. MSS does not use RADIUS for last-resort authentication.

The following commands configure last-resort access for SSID *guest-wlan*. The service profile is configured to encrypt user traffic on the SSID using 40-bit dynamic WEP, WPA, or RSN, depending on the client's configuration.

```
WX1200# set service-profile last-resort-srvcprof ssid-name guest-wlan
success: change accepted.
WX1200# set service-profile last-resort-srvcprof auth-fallthru last-resort
success: change accepted.
WX1200# set service-profile last-resort-srvcprof attr vlan-name guest-vlan
success: change accepted.
WX1200# set service-profile last-resort-srvcprof rsn-ie enable
success: change accepted.
WX1200# set service-profile last-resort-srvcprof wpa-ie enable
success: change accepted.
WX1200# set service-profile last-resort-srvcprof cipher-ccmp enable
success: change accepted.
WX1200# set service-profile last-resort-srvcprof cipher-wep40 enable
success: change accepted.
WX1200# display service-profile last-resort-srvcprof
ssid-name:                   guest-wlan   ssid-type:                         crypto
Beacon:                             yes   Proxy ARP:                             no
DHCP restrict:                       no   No broadcast:                          no
Short retry limit:                    5   Long retry limit:                       5
Auth fallthru:              last-resort   Sygate On-Demand (SODA):               no
Enforce SODA checks:                yes   SODA remediation ACL:
Custom success web-page:                  Custom failure web-page:
Custom logout web-page:                   Custom agent-directory:
Static COS:                          no   COS:                                    0
CAC mode:                          none   CAC sessions:                          14
User idle timeout:                  180   Idle client probing:                  yes
Keep initial vlan:                   no   Web Portal Session Timeout:             5
Web Portal ACL:
WEP Key 1 value:                 <none>   WEP Key 2 value:                   <none>
WEP Key 3 value:                 <none>   WEP Key 4 value:                   <none>
WEP Unicast Index:                  1   WEP Multicast Index:                1
Shared Key Auth:                   NO
WPA and RSN enabled:
    ciphers: cipher-tkip, cipher-ccmp, cipher-wep40
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
vlan-name = guest-vlan
...
```

Beginning with MSS Version 5.0, the special user last-resort-ssid, where ssid is the SSID name, is not required and is not supported. If you upgrade a switch running an earlier version of MSS to 5.0, the last-resort-ssid users are automatically removed from the configuration during the upgrade.

Configuring Last-Resort Access for Wired Authentication Ports

To configure a wired authentication port to allow last-resort access:

- Set the fallthru authentication type on the port to **last-resort**.
- Create a user named last-resort-wired in the switch's local database.

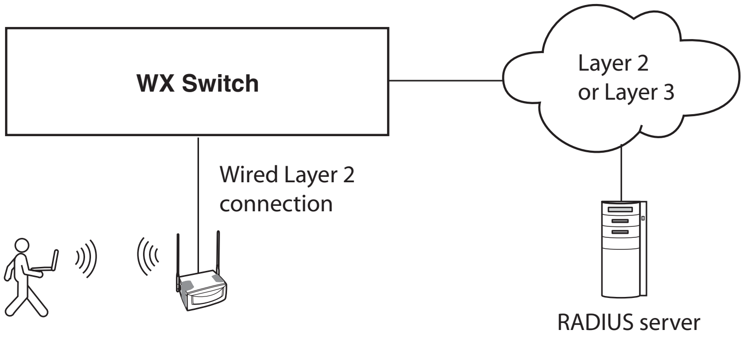
The following commands configure wired authentication port 5 for last-resort access and add the special user:

```
WX1200# set port type wired-auth 5 auth-fall-thru last-resort
success: change accepted.
WX1200# set user last-resort-wired attr vlan-name guest-vlan2
success: change accepted.
```

Configuring AAA for Users of Third-Party APs

A WX switch can provide network access for users associated with a third-party AP that has authenticated the users with RADIUS. You can connect a third-party AP to a WX switch and configure the WX to provide authorization for clients who authenticate and access the network through the AP. Figure 32 shows an example.

Figure 32 WX Switch Serving as RADIUS Proxy



Authentication Process for Users of a Third-Party AP

The authentication process for users of a third-party AP is as follows:

1. MSS uses MAC authentication to authenticate the AP.
2. The user contacts the AP and negotiates the authentication protocol to be used.
3. The AP, acting as a RADIUS client, sends a RADIUS access-request to the WX. The access-request includes the SSID, the user's MAC address, and the username.
4. For 802.1X users, the AP uses 802.1X to authenticate the user, using the WX as its RADIUS server. The WX proxies RADIUS requests from the AP to a real RADIUS server, depending on the authentication method specified in the proxy authentication rule for the user.

   For non-802.1X users, the AP does not use 802.1X. The WX sends a RADIUS query for the special username **web-portal-*ssid*** or **last-resort-*ssid***, where *ssid* is the SSID name. The fallthru authentication type (**web-portal** or **last-resort**) specified for the wired authentication port connected to the AP determines which username is used.

For any users of an AP that sends SSID traffic to the WX on an untagged VLAN, the WX does not use 802.1X. The WX sends a RADIUS query for the special username **web-portal-wired** or **last-resort-wired**, depending on the fallthru authentication type specified for the wired authentication port.

5 After successful RADIUS authentication of the user (or special username, for non-802.1X users), MSS assigns authorization attributes to the user from the RADIUS server's access-accept response.

6 When the user's session ends, the third-party AP sends a RADIUS stop-accounting record to the WX. The WX then removes the session.

Requirements

Third-Party AP Requirements

- The third-party AP must be connected to the WX switch through a wired Layer 2 link. MSS cannot provide data services if the AP and WX are in different Layer 3 subnets.
- The AP must be configured as the WX's RADIUS client.
- The AP must be configured so that all traffic for a given SSID is mapped to the same 802.1Q tagged VLAN. If the AP has multiple SSIDs, each SSID must use a different tag value.
- The AP must be configured to send the following information in a RADIUS access-request, for each user who wants to connect to the WLAN through the WX switch:
  - SSID requested by the user. The SSID can be attached to the end of the called-station-id (per Congdon), or can be in a VSA (for example, *cisco-vsa:ssid=r12-cisco-1*).
  - Calling-station-id that includes the user's MAC address. The MAC address can be in any of the following formats:

    — Separated by colons (for example, AA:BB:CC:DD:EE:FF)

    — Separated by dashes (for example, AA-BB-CC-DD-EE-FF)

    — Separated by dots (for example, AABB.CCDD.EEFF)
  - Username
- The AP must be configured to send a RADIUS stop-accounting record when a user's session ends.

WX Switch Requirements

- The WX port connected to the third-party AP must be configured as a wired authentication port. If SSID traffic from the AP is tagged, the same VLAN tag value must be used on the wired authentication port.
- A MAC authentication rule must be configured to authenticate the AP.
- The WX must be configured as a RADIUS proxy for the AP. The WX is a RADIUS server to the AP but remains a RADIUS client to the real RADIUS servers.

The WX system IP address must be the same as the IP address configured on the VLAN that contains the proxy port.

- An authentication proxy rule must be configured for the AP's users. The rule matches based on SSID and username, and selects the authentication method (a RADIUS server group) for proxying.

RADIUS Server Requirements

- For 802.1X users, the usernames and passwords must be configured on the RADIUS server.
- For non-802.1X users of a tagged SSID, the special username **web-portal-*ssid*** or **last-resort-*ssid*** must be configured, where *ssid* is the SSID name. The fallthru authentication type (**web-portal** or **last-resort**) specified for the wired authentication port connected to the AP determines which username you need to configure.
- For any users of an untagged SSID, the special username **web-portal-wired** or **last-resort-wired** must be configured, depending on the fallthru authentication type specified for the wired authentication port.

Configuring Authentication for 802.1X Users of a Third-Party AP with Tagged SSIDs

To configure MSS to authenticate 802.1X users of a third-party AP, use the commands below to do the following:

- Configure the port connected to the AP as a wired authentication port. Use the following command:

```
set port type wired-auth port-list [tag tag-list]
[max-sessions num]
  [auth-fall-thru {last-resort | none | web-portal}]
```

- Configure a MAC authentication rule for the AP. Use the following command:

```
set authentication mac wired mac-addr-glob method1
```

- Configure the WX port connected to the AP as a RADIUS proxy for the SSID supported by the AP. If SSID traffic from the AP is tagged, assign the same tag value to the WX port. Use the following command:

```
set radius proxy port port-list [tag tag-value] ssid
ssid-name
```

- Add a RADIUS proxy entry for the AP. The proxy entry specifies the IP address of the AP and the UDP ports on which the WX switch listens for RADIUS access-requests and stop-accounting records from the AP. Use the following command:

```
set radius proxy client address ip-address [port
udp-port-number] [acct-port acct-udp-port-number] key string
```

- Configure a proxy authentication rule for the AP's users. Use the following command:

```
set authentication proxy ssid ssid-name user-glob
radius-server-group
```

For the *port-list* of the **set port type wired-auth** and **set radius proxy port** commands, specify the WX port(s) connected to the third-party AP.

For the *ip-address* of the **set radius proxy client address** command, specify the IP address of the RADIUS client (the third-party AP). For the *udp-port-number*, specify the UDP port on which the WX switch will listen for RADIUS access-requests. The default is UDP port 1812. For the *acct-udp-port-number*, specify the UDP port on which the WX switch will listen for RADIUS stop-accounting records. The default is UDP port 1813.

The following command configures WX ports 3 and 4 as wired authentication ports, and assigns tag value 104 to the ports:

```
WX4400# set port type wired-auth 3-4 tag 104
success: change accepted.
```

You can specify multiple tag values. Specify the tag value for each SSID you plan to support.

The following command configures a MAC authentication rule that matches on the third-party AP's MAC address. Because the AP is connected to the WX switch on a wired authentication port, the **wired** option is used.

```
WX4400# set authentication mac wired aa:bb:cc:01:01:01
srvrgrp1
success: change accepted.
```

The following command maps SSID *mycorp* to packets received on port 3 or 4, using 802.1Q tag value 104:

```
WX4400# set radius proxy port 3-4 tag 104 ssid mycorp
success: change accepted.
```

Enter a separate command for each SSID, and its tag value, you want the WX to support.

The following command configures a RADIUS proxy entry for a third-party AP RADIUS client at 10.20.20.9, sending RADIUS traffic to the default UDP ports 1812 and 1813 on the WX:

```
WX2200# set radius proxy client address 10.20.20.9 key
radkey1
success: change accepted.
```

The IP address is the AP's IP address. The key is the shared secret configured on the RADIUS servers. MSS uses the shared secret to authenticate and encrypt RADIUS communication.

The following command configures a proxy authentication rule that matches on all usernames associated with SSID *mycorp*. MSS uses RADIUS server group *srvrgrp1* to proxy RADIUS requests and hence to authenticate and authorize the users.

```
WX4400# set authentication proxy ssid mycorp ** srvrgrp1
```

MSS also uses the server group you specify with this command for accounting.

To verify the changes, use the **display config area aaa** command.

Configuring Authentication for Non-802.1X Users of a Third-Party AP with Tagged SSIDs

To configure MSS to authenticate non-802.1X users of a third-party AP, use the same commands as those required for 802.1X users. Additionally, when configuring the wired authentication port, use the **auth-fall-thru** option to change the fallthru authentication type to **last-resort** or **web-portal**.

On the RADIUS server, configure username **web-portal-*ssid*** or **last-resort-*ssid***, depending on the fallthru authentication type you specify for the wired authentication port.

Configuring Access for Any Users of a Non-Tagged SSID

If SSID traffic from the third-party AP is untagged, use the same configuration commands as the ones required for 802.1X users, except the **set radius proxy port** command. This command is not required and is not applicable to untagged SSID traffic. In addition, when configuring the wired authentication port, use the **auth-fall-thru** option to change the fallthru authentication type to **last-resort** or **web-portal**.

On the RADIUS server, configure username **web-portal-wired** or **last-resort-wired**, depending on the fallthru authentication type specified for the wired authentication port.

Assigning Authorization Attributes

Authorization attributes can be assigned to users in the local database on remote servers, or in the service profile of the SSID the user logs into. The attributes, which include access control list (ACL) filters, VLAN membership, encryption type, session time-out period, and other session characteristics, let you control how and when users access the network. When a user or group is authenticated, the local database, RADIUS server, or service profile passes the authorization attributes to MSS to characterize the user's session.

If attributes are configured for a user and also for the group the user is in, the attributes assigned to the individual user take precedence for that user. For example, if the start-date attribute configured for a user is sooner than the start-date configured for the user group the user is in, the user's network access can begin as soon as the user start-date. The user does not need to wait for the user group's start date.

The VLAN attribute is required. MSS can authorize a user to access the network only if the VLAN to place the user on is specified.

Table 43 lists the authorization attributes supported by MSS. (For brief descriptions of all the RADIUS attributes and 3Com vendor-specific attributes supported by MSS, as well as the vendor ID and types for 3Com VSAs configured on a RADIUS server "Supported RADIUS Attributes" on page 651.)

Table 43 Authentication Attributes for Local Users

Attribute	Description	Valid Value(s)
acct-interim-interval	Interval in seconds between accounting updates, if start-stop accounting mode is enabled.	Number between 180 and 3600 seconds, or 0 to disable periodic accounting updates. Notes: ▪ The WX switch ignores the **acct-interim-interval** value and issues a log message if the value is below 60 seconds. ▪ If both a RADIUS server and the WX switch supply a value for the **acct-interim-interval** attribute, then the value from the WX switch takes precedence.
encryption-type	Type of encryption required for access by the client. Clients who attempt to use an unauthorized encryption method are rejected.	One of the following numbers that identifies an encryption algorithm: ▪ **1** — AES_CCM (Advanced Encryption Standard using Counter with CBC-MAC) ▪ **2** — Reserved ▪ **4** — TKIP (Temporal Key Integrity Protocol) ▪ **8** — WEP_104 (the default) (Wired-Equivalent Privacy protocol using 104 bits of key strength) ▪ **16** — WEP_40 (Wired-Equivalent Privacy protocol using 40 bits of key strength) ▪ **32** — NONE (no encryption) ▪ **64** — Static WEP In addition to these values, you can specify a sum of them for a combination of allowed encryption types. For example, to specify WEP_104 and WEP_40, use **24**.

Table 43 Authentication Attributes for Local Users (continued)

Attribute	Description	Valid Value(s)
end-date	Date and time after which the user is no longer allowed to be on the network.	Date and time, in the following format: *YY/MM/DD-HH:MM* You can use **end-date** alone or with **start-date**. You also can use **start-date**, **end-date**, or both in conjunction with **time-of-day**.
filter-id (network access mode only)	Security access control list (ACL), to permit or deny traffic received (input) or sent (output) by the WX switch. (For more information about security ACLs, see Chapter 19, "Configuring and Managing Security ACLs," on page 377.)	Name of an existing security ACL, up to 32 alphanumeric characters, with no tabs or spaces. ▪ Use *acl-name***.in** to filter traffic that enters the switch *from users* via a MAP access port or wired authentication port, or from the network via a network port. ▪ Use *acl-name***.out** to filter traffic sent from the switch *to users* via a MAP access port or wired authentication port, or from the network via a network port. If the Filter-Id value returned through the authentication and authorization process does not match the name of a committed security ACL in the WX, the user fails authorization and is unable to authenticate.
idle-timeout	This option is not implemented in the current MSS version.	
mobility-profile (network access mode only)	Mobility Profile attribute for the user. (For more information, see "Configuring a Mobility Profile" on page 510.)	Name of an existing Mobility Profile, which can be up to 32 alphanumeric characters, with no tabs or spaces. **Note:** If the Mobility Profile feature is enabled, and a user is assigned the name of a Mobility Profile that does not exist on the WX switch, the user is denied access.

Table 43 Authentication Attributes for Local Users (continued)

Attribute	Description	Valid Value(s)
service-type	Type of access the user is requesting.	One of the following numbers: **2**—Framed; for network user access **6**—Administrative; for administrative access to the WX switch, with authorization to access the enabled (configuration) mode. The user must enter the **enable** command to access the enabled mode. **7**—NAS-Prompt; for administrative access to the nonenabled mode only. In this mode, the **enable** command is not available and the user cannot log in to the enabled mode. For administrative sessions, the WX switch will send 7 (NAS-Prompt) unless the service-type attribute has been configured for the user. The RADIUS server can reply with one of the values listed above. If the service-type is not set on the RADIUS server, administrative users receive NAS-Prompt access, and network users receive Framed access. Note: MSS will quietly accept Callback Framed, but you cannot select this access type in MSS.
session-timeout (network access mode only)	Maximum number of seconds for the user's session.	Number between 0 and 4,294,967,296 seconds (approximately 136.2 years).
ssid (network access mode only)	SSID the user is allowed to access after authentication.	Name of the SSID you want the user to use. The SSID must be configured in a service profile, and the service profile must be used by a radio profile assigned to 3Com radios in the Mobility Domain.

Table 43 Authentication Attributes for Local Users (continued)

Attribute	Description	Valid Value(s)
start-date	Date and time at which the user becomes eligible to access the network. MSS does not authenticate the user unless the attempt to access the network occurs at or after the specified date and time, but before the end-date (if specified).	Date and time, in the following format: *YY/MM/DD-HH:MM* You can use **start-date** alone or with **end-date**. You also can use **start-date**, **end-date**, or both in conjunction with **time-of-day**.
time-of-day (network access mode only)	Day(s) and time(s) during which the user is permitted to log into the network. After authorization, the user's session can last until either the Time-Of-Day range or the Session-Timeout duration (if set) expires, whichever is shorter.	One of the following: ▪ **never** — Access is always denied. ▪ **any** — Access is always allowed. ▪ **al** — Access is always allowed. ▪ One or more ranges of values that consist of one of the following day designations (required), and a time range in *hhmm-hhmm* 4-digit 24-hour format (optional): **mo** — Monday **tu** — Tuesday **we** — Wednesday **th** — Thursday **fr** — Friday **sa** — Saturday **su** — Sunday **wk** — Any day between Monday and Friday Separate values or a series of ranges (except time ranges) with commas (,) or a vertical bar (|). Do not use spaces. The maximum number of characters is 253. For example, to allow access only on Tuesdays and Thursdays between 10 a.m. and 4 p.m., specify the following: **time-of-day tu1000-1600,th1000-1600** To allow access only on weekdays between 9 a.m and 5 p.m., and on Saturdays from 10 p.m. until 2 a.m., specify the following: **time-of-day wk0900-1700,sa2200-0200** **Note:** You can use **time-of-day** in conjunction with **start-date**, **end-date**, or both.

Table 43 Authentication Attributes for Local Users (continued)

Attribute	Description	Valid Value(s)
url (network access mode only)	URL to which the user is redirected after successful WebAAA.	Web URL, in standard format. For example: **http://www.example.com** **Note:** You must include the **http://** portion. You can dynamically include any of the variables in the URL string: - **$u**—Username - **$v**—VLAN - **$s**—SSID - **$p**—Service profile name To use the literal character $ or ?, use the following: - **$$** - **$q**
vlan-name (network access mode only)	Virtual LAN (VLAN) assignment. **Note:** On some RADIUS servers, you might need to use the standard RADIUS attribute Tunnel-Pvt-Group-ID, instead of VLAN-Name.	Name of a VLAN that you want the user to use. The VLAN must be configured on a WX switch within the Mobility Domain to which this WX switch belongs.

Assigning Attributes to Users and Groups

You can assign authorization attributes to individual users or groups of users. Use any of the following commands to assign an attribute to a user or group in the local WX database and specify its value:

```
set user username attr attribute-name value
set usergroup group-name attr attribute-name value
set mac-user mac-addr attr attribute-name value
set mac-usergroup group-name attr attribute-name value
```

If attributes are configured for a user and also for the group the user is in, the attributes assigned to the individual user take precedence for that user. For example, if the start-date attribute configured for a user is sooner than the start-date configured for the user group the user is in, the user's network access can begin as soon as the user start-date. The user does not need to wait for the user group's start date.

To change the value of an authorization attribute, reenter the command with the new value.

To assign an authorization attribute to a user's configuration on a RADIUS server, see the documentation for your RADIUS server.

Assigning SSID Default Attributes to a Service Profile

You can configure a service profile with a set of default AAA authorization attributes that are used when the normal AAA process or a location policy does not provide them. These authorization attributes are applied by default to users accessing the SSID managed by the service profile.

Use the following command to assign an authorization attribute to a service profile and specify its value:

```
set service-profile name attr attribute-name value
```

By default, a service profile contains no SSID default authorization attributes. When specified, attributes in a service profile are applied *in addition* to any attributes supplied for the user by the RADIUS server or the local database. When the same attribute is specified both as an SSID default attribute and through AAA, then the attribute supplied by the RADIUS server or the local database takes precedence over the SSID default attribute. If a location policy is configured, the location policy takes precedence over both AAA and SSID default attributes. The SSID default attributes serve as a fallback when neither the AAA process, nor a location policy, provides them.

For example, a service profile might be configured with the **service-type** attribute set to *2*. If a user accessing the SSID is authenticated by a RADIUS server, and the RADIUS server returns the **vlan-name** attribute set to *orange*, then that user will have a total of two attributes set: **service-type** and **vlan-name**.

If the service profile is configured with the **vlan-name** attribute set to *blue*, and the RADIUS server returns the **vlan-name** attribute set to *orange*, then the attribute from the RADIUS server takes precedence; the user is placed in the orange VLAN.

You can display the attributes for each connected user and whether they are set through AAA or through SSID defaults by entering the **display sessions network verbose** command. You can display the configured SSID defaults by entering the **display service-profile** command.

All of the authorization attributes listed in Table 40 on page 448 can be specified in a service profile except **ssid**.

Assigning a Security ACL to a User or a Group

Once a security access control list (ACL) is defined and committed, it can be applied dynamically and automatically to users and user groups through the 802.1X authentication and authorization process. When you assign a Filter-Id attribute to a user or group, the security ACL name value is entered as an authorization attribute into the user or group record in the local WX database or RADIUS server.

If the Filter-Id value returned through the authentication and authorization process does not match the name of a committed security ACL in the WX, the user fails authorization and cannot be connected.

(For details about security ACLs, see Chapter 19, "Configuring and Managing Security ACLs," on page 377.)

Assigning a Security ACL Locally

To use the local WX database to restrict a user, a MAC user, or a group of users or MAC users to the permissions stored within a committed security ACL, use the commands shown in Table 44.

Table 44 Commands for Assigning a Security ACL Locally

Security ACL Target	Commands
User authenticated by a password	**set user** *username* **attr filter-id** *acl-name*.**in** **set user** *username* **attr filter-id** *acl-name*.**out**
Group of users authenticated by a password	**set usergroup** *groupname* **attr filter-id** *acl-name*.**in** **set usergroup** *groupname* **attr filter-id** *acl-name*.**out**
User authenticated by a MAC address	**set mac-user** *username* **attr filter-id** *acl-name*.**in** **set mac-user** *username* **attr filter-id** *acl-name*.**out**
Group of users authenticated by a MAC address	**set mac-usergroup** *groupname* **attr filter-id** *acl-name*.**in** **set mac-usergroup** *groupname* **attr filter-id** *acl-name*.**out**

You can set filters for incoming and outgoing packets:

- Use *acl-name***.in** to filter traffic that enters the WX switch *from users* via a MAP access port or wired authentication port, or from the network via a network port.
- Use *acl-name***.out** to filter traffic sent from the WX switch *to users* via a MAP access port or wired authentication port, or from the network via a network port.

For example, the following command applies security ACL *acl-101* to packets coming into the WX from user *Jose*:

```
WX1200# set user Jose attr filter-id acl-101.in
success: change accepted.
```

The following command applies the incoming filters of *acl-101* to the users who belong to the group *eastcoasters*:

```
WX1200# set usergroup eastcoasters attr filter-id acl-101.in
success: change accepted.
```

Assigning a Security ACL on a RADIUS Server

To assign a security ACL name as the Filter-Id authorization attribute of a user or group record on a RADIUS server, see the documentation for your RADIUS server.

Clearing a Security ACL from a User or Group

To clear a security ACL from the profile of a user, MAC user, or group of users or MAC users in the local WX database, use the following commands:

```
clear user username attr filter-id
clear usergroup groupname attr filter-id
clear mac-user username attr filter-id
clear mac-usergroup groupname attr filter-id
```

If you have assigned both an incoming and an outgoing filter to a user or group, enter the appropriate command twice to delete both security ACLs. Verify the deletions by entering the **display aaa** command and checking the output.

To delete a security ACL from a user's configuration on a RADIUS server, see the documentation for your RADIUS server.

Assigning Encryption Types to Wireless Users

When a user turns on a wireless laptop or PDA, the device attempts to find an access point and form an association with it. Because MAPs support the encryption of wireless traffic, clients can choose an encryption type to use. You can configure MAPs to use the encryption algorithms supported by the Wi-Fi Protected Access (WPA) security enhancement to the IEEE 802.11 wireless standard. (For details, see Chapter 13, "Configuring User Encryption," on page 281.)

If you have configured MAPs to use specific encryption algorithms, you can enforce the type of encryption a user or group must have to access the network. When you assign the Encryption-Type attribute to a user or group, the encryption type or types are entered as an authorization attribute into the user or group record in the local WX database or on the RADIUS server. Encryption-Type is a 3Com vendor-specific attribute (VSA).

Clients who attempt to use an unauthorized encryption method are rejected.

Assigning and Clearing Encryption Types Locally

To restrict wireless uses or groups with user profiles in the local WX database to particular encryption algorithms for accessing the network, use one of the following commands:

```
set user username attr encryption-type value
set usergroup groupname attr encryption-type value
set mac-user username attr encryption-type value
set mac-usergroup groupname attr encryption-type value
```

MSS supports the values for Encryption-Type shown in Table 45. The values are listed from most secure to least secure. (For user encryption details, see Chapter 13, "Configuring User Encryption," on page 281.)

Table 45 Encryption Type Values and Associated Algorithms

Encryption-Type Value	Encryption Algorithm Assigned
1	Advanced Encryption Standard using Counter with Cipher Block Chaining Message Authentication Code (CBC-MAC) — or AES_CCM.
2	Reserved.
4	Temporal Key Integrity Protocol (TKIP).

Table 45 Encryption Type Values and Associated Algorithms (continued)

Encryption-Type Value	Encryption Algorithm Assigned
8	Wired-Equivalent Privacy protocol using 104 bits of key strength (WEP_104). This is the default.
16	Wired-Equivalent Privacy protocol using 40 bits of key strength (WEP_40).
32	No encryption.
64	Static WEP

For example, the following command restricts the MAC user group *mac-fans* to access the network by using only TKIP:

```
WX1200# set mac-usergroup mac-fans attr encryption-type 4
success: change accepted.
```

You can also specify a combination of allowed encryption types by summing the values. For example, the following command allows *mac-fans* to associate using either TKIP or WEP_104:

```
WX1200# set mac-usergroup mac-fans attr encryption-type 12
success: change accepted.
```

To clear an encryption type from the profile of a use or group of users in the local WX database, use one of the following commands:

```
clear user username attr encryption-type
clear usergroup groupname attr encryption-type
clear mac-user username attr encryption-type
clear mac-usergroup groupname attr encryption-type
```

Assigning and Clearing Encryption Types on a RADIUS Server

To assign or delete an encryption algorithm as the Encryption-Type authorization attribute in a user or group record on a RADIUS server, see the documentation for your RADIUS server.

Keeping Users on the Same VLAN Even After Roaming

In some cases, a user can be assigned to a different VLAN after roaming to another WX switch.

Table 46 lists the ways a VLAN can be assigned to a user after roaming from one WX to another.

Table 46 VLAN Assignment After Roaming from One WX to Another

Location Policy	AAA	keep-initial-vlan	SSID	VLAN Assigned By...
Yes	Yes or No	Yes or No	Yes or No	location policy
No	Yes	Yes or No	Yes or No	AAA
No	No	Yes	Yes or No	keep-initial-vlan
No	No	No	Yes	SSID
No	No	No	No	Not set—authentication error

Yes in the table means the VLAN is set on the roamed-to WX, by the mechanism indicated by the column header. *No* means the VLAN is not set. *Yes or No* means the mechanism does not affect the outcome, due to another mechanism that is set.

The *VLAN Assigned By* column indicates the mechanism that is used by the roamed-to switch to assign the VLAN, based on the various ways the VLAN is set on that switch.

- *Location Policy* means the VLAN is assigned by a location policy on the roamed-to switch. (The VLAN is assigned by the **vlan** *vlan-id* option of the **set location policy permit** command.)
- *AAA* means the Vlan-name attribute is set on for the user or the user's group, in the roamed-to switch's local database or on a RADIUS server used by the roamed-to switch to authenticate the user. (The VLAN is assigned by the **vlan-name** *vlan-id* option of the **set user attr**, **set usergroup attr**, **set mac-user**, or **set mac-usergroup** command.)
- *keep-initial-vlan* means that the VLAN is not reassigned. Instead, the VLAN assigned on the switch where the user first accesses the network is retained. (The **keep-initial-vlan** option is enabled by the **set service-profile** *name* **keep-initial-vlan enable** command, entered on the roamed-to switch. The *name* is the name of the service profile for the SSID the user is associated with.)

- *SSID* means the VLAN is set on the roamed-to switch, in the service profile for the SSID the user is associated with. (The Vlan-name attribute is set by the **set service-profile** *name* **attr vlan-name** *vlan-id* command, entered on the roamed-to switch. The *name* is the name of the service profile for the SSID the user is associated with.)
- As shown in Table 46, even when **keep-initial-vlan** is set, a user's VLAN can be reassigned by AAA or a location policy.

The keep-initial-vlan option does not apply to Web-Portal clients. Instead, VLAN assignment for roaming Web-Portal clients automatically works the same way as when keep-initial-vlan is enabled. The VLAN initially assigned to a Web-Portal user is not changed except by a location policy, AAA, or SSID default setting on the roamed-to switch.

To enable **keep-initial-vlan**, use the following command:

```
set service-profile name keep-initial-vlan {enable | disable}
```

Enter this command on the switch that will be roamed to by users.

The following command enables the **keep-initial-vlan** option on service profile *sp3*:

```
WX1200# set service-profile sp3 keep-initial-vlan enable
success: change accepted.
```

Overriding or Adding Attributes Locally with a Location Policy

During the login process, the AAA authorization process is started immediately after clients are authenticated to use the WX switch. During authorization, MSS assigns the user to a VLAN and applies optional user attributes, such as a session timeout value and one or more security ACL filters.

A *location policy* is a set of rules that enables you to locally set or change authorization attributes for a user after the user is authorized by AAA, without making changes to the AAA server. For example, you might want to enforce VLAN membership and security ACL policies on a particular WX based on a client's organization or physical location, or assign a VLAN to users who have no AAA assignment. For these situations, you can configure the location policy on the switch.

You can use a location policy to locally set or change the Filter-Id and VLAN-Name authorization attributes obtained from AAA.

About the Location Policy

Each WX switch can have one location policy. The location policy consists of a set of rules. Each rule contains conditions, and an action to perform if all conditions in the rule match. The location policy can contain up to 50 rules.

The action can be one of the following:

- Deny access to the network
- Permit access, but set or change the user's VLAN assignment, inbound ACL, outbound ACL, or any combination of these attributes

The conditions can be one or more of the following:

- AAA-assigned VLAN
- Username
- MAP access port, Distributed MAP number, or wired authentication port through which the user accessed the network
- SSID name with which the user is associated

Conditions within a rule are ANDed. All conditions in the rule must match in order for MSS to take the specified action. If the location policy contains multiple rules, MSS compares the user information to the rules one at a time, in the order the rules appear in the switch's configuration file, beginning with the rule at the top of the list. MSS continues comparing until a user matches all conditions in a rule or until there are no more rules.

Any authorization attributes not changed by the location policy remain active.

How the Location Policy Differs from a Security ACL

Although structurally similar, the location policy and security ACLs have different functions. The location policy on a WX switch can be used to locally redirect a user to a different VLAN or locally control the traffic to and from a user.

In contrast, security ACLs are packet filters applied to the user throughout a Mobility Domain. (For more information, see Chapter 19, "Configuring and Managing Security ACLs," on page 377.)

You can use the location policy to locally apply a security ACL to a user.

Setting the Location Policy

To enable the location policy function on a WX switch, you must create at least one location policy rule with one of the following commands:

```
set location policy deny if
{ssid operator ssid-name | vlan operator vlan-glob | user
operator user-glob | port port-list | dap dap-num} [before
rule-number | modify rule-number]
```

```
set location policy permit
{vlan vlan-name | inacl inacl-name | outacl outacl-name}
if {ssid operator ssid-name | vlan operator vlan-glob | user
operator user-glob | port port-list | dap dap-num}
[before rule-number | modify rule-number]
```

Asterisks (wildcards) are not supported in SSID names. You must specify the complete SSID name.

You must specify whether to permit or deny access, and you must identify a VLAN, username, or access port to match. Use one of the following operators to specify how the rule must match the VLAN or username:

- **eq** — Applies the location policy rule to all users assigned VLAN names matching *vlan-glob* or having usernames that match *user-glob*.

  (Like a user glob, a VLAN glob is a way to group VLANs for use in this command. For more information, see “VLAN Globs” on page 31.)
- **neq** — Applies the location policy rule to all users assigned VLAN names *not* matching *vlan-glob* or having usernames that *do not* match *user-glob*.

For example, the following command denies network access to all users matching *.theirfirm.com, causing them to fail authorization:

```
WX1200# set location policy deny if user eq *.theirfirm.com
```

The following command authorizes access to the *guest_1* VLAN for all users who do not match **.ourfirm.com*:

```
WX1200# set location policy permit vlan guest_1 if user neq
*.ourfirm.com
```

The following command places all users who are authorized for SSID *tempvendor_a* into VLAN *kiosk_1*:

```
WX1200# set location policy permit vlan kiosk_1 if ssid eq
tempvendor_a
success: change accepted.
```

Applying Security ACLs in a Location Policy Rule

When reassigning security ACL filters, specify whether the filter is an input filter or an output filter, as follows:

- **Input filter** — Use **inacl** *inacl-name* to filter traffic that *enters* the switch from users via a MAP access port or wired authentication port, or from the network via a network port.
- **Output filter** — Use **outacl** *outacl-name* to filter traffic sent *from* the switch to users via a MAP access port or wired authentication port, or from the network via a network port.

For example, the following command authorizes users at *.ny.ourfirm.com to access the *bld4.tac* VLAN, and applies the security ACL *tac_24* to the traffic they receive:

```
WX1200# set location policy permit vlan bld4.tac outacl
tac_24 if user eq *.ny.ourfirm.com
```

The following command authorizes access to users on VLANs with names matching *bld4.** and applies security ACLs *svcs_2* to the traffic they send and *svcs_3* to the traffic they receive:

```
WX1200# set location policy permit inacl svcs_2
outacl svcs_3 if vlan eq bldg4.*
```

You can optionally add the suffixes **.in** and **.out** to *inacl-name* and *outacl-name* for consistency with their usage in entries stored in the local WX database.

Displaying and Positioning Location Policy Rules

The order of location policy rules is significant. MSS checks a location policy rule that is higher in the list before those lower in the list. Rules are listed in the order in which you create them, unless you move them.

To position location policy rules within the location policy, use **before** *rule-number* and **modify** *rule-number* in the **set location policy** command, or use the **clear location policy** *rule-number* command.

For example, suppose you have configured the following location policy rules:

```
WX1200 display location policy
Id Clauses
----------------------------------------------------------------
1) deny if user eq *.theirfirm.com
2) permit vlan guest_1 if vlan neq *.ourfirm.com
3) permit vlan bld4.tac inacl tac_24.in if user eq *.ny.ourfirm.com
4) permit inacl svcs_2.in outacl svcs_3.out if vlan eq bldg4.*
To move the first rule to the end of the list and display the results, type the
following commands:
WX1200 clear location policy 1
success: clause 1 is removed.
WX1200 set location policy deny if user eq
*.theirfirm.com
WX1200 display location policy
Id Clauses
----------------------------------------------------------------
1) permit vlan guest_1 if vlan neq *.ourfirm.com
2) permit vlan bld4.tac inacl tac_24.in if user eq *.ny.ourfirm.com
3) permit inacl svcs_2.in outacl svcs_3.out if vlan eq bldg4.*
4) deny if user eq *.theirfirm.com
```

Clearing Location Policy Rules and Disabling the Location Policy

To delete a location policy rule, use the following command:

`clear location policy` *`rule-number`*

Type **display location policy** to display the numbers of configured location policy rules. To disable the location policy on a WX switch, delete all the location policy rules.

Configuring Accounting for Wireless Network Users

Accounting records come in three types: start-stop, stop-only, and update for network users. The records provide information about network resource usage.

To set accounting, type the following command:

```
set accounting {admin | console | dot1x |
mac | web | last-resort} {ssid ssid-name | wired}
{user-glob | mac-addr-glob} {start-stop  | stop-only}
method1 [method2] [method3] [method4]
```

For example, to store start-stop accounting records at example.com for 802.1X users of SSID *mycorp* in the local database, type the following command:

```
WX1200# set accounting dot1x ssid mycorp *@example.com
start-stop local
success: change accepted.
```

The accounting records can contain the session information shown in Table 47.

Table 47 Session Information Shown in Accounting Records

Start Records	Update and Stop Records
Session date and time	Session date and time
Location of authentication (if any): RADIUS server (1) or local database (2)	Location of authentication (if any): RADIUS server (1) or local database (2)
ID for related sessions	ID for related sessions
Username	Username
Session duration	Session duration
Timestamp	Timestamp
VLAN name	VLAN name
Client's MAC address	Client's MAC address
MAP port number and radio number	MAP port number and radio number
MAP's MAC address	MAP's MAC address
	Number of octets received by the WX switch
	Number of octets sent by the switch
	Number of packets received by the switch
	Number of packets sent by the switch

(For details about **display accounting statistics** output, see the *Wireless LAN Switch and Controller Command Reference*. For information about accounting update records, see “Viewing Roaming Accounting Records” on page 505. To configure accounting on a RADIUS server, see the documentation for your RADIUS server.)

Viewing Local Accounting Records

To view local accounting records, type the following command:

```
WX1200# display accounting statistics
```

Viewing Roaming Accounting Records

During roaming, accounting is treated as a continuation of an existing session, rather than a new session. The following sample output shows a wireless user roaming from one WX switch to another WX switch.

From the accounting records, you can determine the user’s activities by viewing the Acct-Status-Type, which varies from START to UPDATE to STOP, and the Called-Station-Id, which is the MAC address of the MAP through which the wireless user accessed the network. The Acct-Multi-Session-Id is guaranteed to be globally unique for the client.

By entering **display accounting statistics** commands on each WX switch involved in the roaming, you can determine the user’s movements between WX switches when accounting is configured locally.

The user started on WX1200-0013:

```
WX1200-0013# display accounting statistics
May 21 17:01:32
Acct-Status-Type=START
Acct-Authentic=2
User-Name=Administrator@example.com
Acct-Multi-Session-Id=SESSION-4-1106424789
Event-Timestamp=1053536492
Vlan-Name=default
Calling-Station-Id=00-06-25-09-39-5D
Nas-Port-Id=1/1
Called-Station-Id=00-0B-0E-76-56-A8
```

The user roamed to WX1200-0017.

```
WX1200-0017# display accounting statistics
May 21 17:05:00
Acct-Status-Type=UPDATE
Acct-Authentic=2
Acct-Multi-Session-Id=SESSION-4-1106424789
```

```
User-Name=Administrator@example.com
Acct-Session-Time=209
Acct-Output-Octets=1280
Acct-Input-Octets=1920
Acct-Output-Packets=10
Acct-Input-Packets=15
Event-Timestamp=1053536700
Vlan-Name=default
Calling-Station-Id=00-06-25-09-39-5D
Nas-Port-Id=2/1
Called-Station-Id=00-0B-0E-76-56-A0
```

The user terminated the session on WX1200-0017:

```
WX1200-0017# display accounting statistics
May 21 17:07:32
Acct-Status-Type=STOP
Acct-Authentic=2
Acct-Multi-Session-Id=SESSION-4-1106424789
User-Name=Administrator@example.com
Acct-Session-Time=361
Event-Timestamp=1053536852
Acct-Output-Octets=2560
Acct-Input-Octets=5760
Acct-Output-Packets=20
Acct-Input-Packets=45
Vlan-Name=default
Calling-Station-Id=00-06-25-09-39-5D
Nas-Port-Id=2/1
Called-Station-Id=00-0B-0E-76-56-A0
```

If you configured accounting records to be sent to a RADIUS server, you can view the records of user roaming at the RADIUS server. (For more information on these attributes, see “Supported RADIUS Attributes” on page 651.)

For information about requesting accounting records from the RADIUS server, see the documentation for your RADIUS server.

Displaying the AAA Configuration

To view the results of the AAA commands you have set and verify their order, type the **display aaa** command. The order in which the commands appear in the output determines the order in which MSS matches them to users.

(Sometimes the order might not be what you intended. See “Avoiding AAA Problems in Configuration Order” on page 508.)

For example:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=0 key=(null) author-pass=(null)
Radius Servers
Server                  Addr           Ports    T/o Tries Dead State
--------------------------------------------------------------------
rs-3                 198.162.1.1     1821 1813  5    3    0    UP
rs-4                 198.168.1.2     1821 1813  77   11   2    UP
rs-5                 198.162.1.3     1821 1813  42   23   0    UP
Server groups
sg1: rs-3
sg2: rs-4
sg3: rs-5
Web Portal:
enabled
set authentication admin Jose sg3
set authentication console * none
set authentication mac ssid mycorp * local
set authentication dot1x ssid mycorp Geetha eap-tls
set authentication dot1x ssid mycorp * peap-mschapv2 sg1 sg2 sg3
set accounting dot1x Nin ssid mycorp stop-only sg2
set accounting admin Natasha start-stop local

user Nin
Password = 082c6c64060b (encrypted)
Filter-Id = acl-999.in
Filter-Id = acl-999.out
mac-user 01:02:03:04:05:06
usergroup eastcoasters
   session-timeout = 99
```

For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.

Avoiding AAA Problems in Configuration Order

This section describes some common AAA configuration issues on the WX switch and how to avoid them.

Using the Wildcard "Any" as the SSID Name in Authentication Rules

You can configure an authentication rule to match on all SSID strings by using the SSID string *any* in the rule. For example, the following rule matches on all SSID strings requested by all users:

```
set authentication web ssid any ** sg1
```

MSS checks authentication rules in the order they appear in the configuration file. As a result, if a rule with SSID **any** appears in the configuration before a rule that matches on a specific SSID for the same authentication type and userglob, the rule with **any** always matches first.

To ensure the authentication behavior that you expect, place the most specific rules first and place rules with SSID **any** last. For example, to ensure that users who request SSID *corpa* are authenticated using RADIUS server group *corpasrvr*, place the following rule in the configuration before the rule with SSID **any**:

```
set authentication web ssid corpa ** corpasrvr
```

Here is an example of a AAA configuration where the most-specific rules for 802.1X and WebAAA are first and the rules with **any** are last:

```
WX1200# display aaa
...
set authentication dot1x ssid mycorp Geetha eap-tls
set authentication dot1x ssid mycorp * peap-mschapv2 sg1 sg2 sg3
set authentication dot1x ssid any ** peap-mschapv2 sg1 sg2 sg3
```

Using Authentication and Accounting Rules Together

When you use accounting commands with authentication commands and identify users with user globs, MSS might not process the commands in the order you entered them. As a result, user authentication or accounting might not proceed as you intend, or valid users might fail authentication and be shut out of the network.

You can prevent these problems by using duplicate user globs for authentication and accounting and entering the commands in pairs.

Configuration Producing an Incorrect Processing Order

For example, suppose you initially set up start-stop accounting as follows for all 802.1X users via RADIUS server group 1:

```
WX1200# set accounting dot1x ssid mycorp * start-stop group1
success: change accepted.
```

You then set up PEAP-MS-CHAP-V2 authentication and authorization for all users at *EXAMPLE/* at server group 1. Finally, you set up PEAP-MS-CHAP-V2 authentication and authorization for all users in the local WX database, with the intention that *EXAMPLE* users are to be processed first:

```
WX1200# set authentication dot1x ssid mycorp EXAMPLE/*
peap-mschapv2 group1
success: change accepted.
WX1200# set authentication dot1x ssid mycorp * peap-mschapv2
local
success: change accepted.
```

The following configuration order results. The authentication commands are reversed, and MSS processes the authentication of all 802.1X users in the local database and ignores the command for EXAMPLE/ users.

```
WX1200# display aaa
...
set accounting dot1x ssid mycorp * start-stop group1
set authentication dot1x ssid mycorp * peap-mschapv2 local
set authentication dot1x ssid mycorp EXAMPLE/* peap-mschapv2 group1
```

Configuration for a Correct Processing Order

To avoid processing errors for authentication and accounting commands that include order-sensitive user globs, enter the commands for each user glob in pairs.

For example, to set accounting and authorization for 802.1X users as you intended in “Configuration Producing an Incorrect Processing Order” on page 509, enter an accounting and authentication command for each user glob in the order in which you want them processed:

```
WX1200# set accounting dot1x ssid mycorp EXAMPLE/* start-stop group1
success: change accepted.
WX1200# set authentication dot1x ssid mycorp EXAMPLE/* peap-mschapv2 group1
success: change accepted.
WX1200# set accounting dot1x ssid mycorp * start-stop group1
success: change accepted.
WX1200# set authentication dot1x ssid mycorp * peap-mschapv2 local
success: change accepted.
```

The configuration order now shows that all 802.1X users are processed as you intended:

```
WX1200# display aaa
...
set accounting dot1x ssid mycorp EXAMPLE/* start-stop group1
set authentication dot1x ssid mycorp EXAMPLE/* peap-mschapv2 group1
set accounting dot1x ssid mycorp * start-stop group1
set authentication dot1x ssid mycorp * peap-mschapv2 local
```

Configuring a Mobility Profile

A Mobility Profile is a way of specifying, on a per-user basis, those users who are allowed access to specified MAP access ports and wired authentication ports on a WX switch. In this way, you can constrain the areas to which a user can roam. You first create a Mobility Profile, assign it to one or more users, and finally enable the Mobility Profile feature on the WX.

CAUTION: *When Mobility Profile attributes are enabled, a user is denied access if assigned a Mobility-Profile attribute in the local WX switch database or RADIUS server and no Mobility Profile of that name exists on the WX switch.*

Use the following command to create a Mobility Profile by giving it a name and identifying the accessible port or ports:

```
set mobility-profile name  name
{port {none | all | port-list}} | {dap {none | all |
dap-num}}
```

Specifying **none** prevents users assigned to the Mobility Profile from accessing any MAP access ports, Distributed MAPs, or wired authentication ports on the WX. Specifying **all** allows the users access to all of the ports or Distributed MAPs.

Specifying an individual port or Distributed MAP number or a list limits access to those ports or MAPs. For example, the following command creates a Mobility Profile named *roses-profile* that allows access through ports 2 through 4 and port 6:

```
WX1200# set mobility-profile name roses-profile port 2-4,6
success: change accepted.
```

You can then assign this Mobility Profile to one or more users. For example, to assign the Mobility Profile *roses-profile* to all users at EXAMPLE\, type the following command:

```
WX1200# set user EXAMPLE\* attr mobility-profile roses-profile
success: change accepted.
```

(For a list of the commands for assigning attributes, see "Assigning Attributes to Users and Groups" on page 492.)

During 802.1X authorization for clients at *EXAMPLE*, MSS must search for the Mobility Profile named *roses-profile*. If it is not found, the authorization fails and clients with usernames like EXAMPLE\jose and EXAMPLE\tamara are rejected.

If *roses-profile* is configured for EXAMPLE\ users on your WX, MSS checks its port list. If, for example, the current port for EXAMPLE\jose's connection is on the list of allowed ports specified in *roses-profile*, the connection is allowed to proceed. If the port is not in the list (for example, EXAMPLE\jose is on port 5, which is not in the port list), the authorization fails and client EXAMPLE\jose is rejected.

The Mobility Profile feature is disabled by default. You must enable Mobility Profile attributes on the WX switch to use it. You can enable or disable the feature for the whole WX only. If the Mobility Profile feature is disabled, all Mobility Profile attributes are ignored.

To put Mobility Profile attributes into effect on a WX, type the following command:

```
WX1200# set mobility-profile mode enable
success: change accepted.
```

To display the name of each Mobility Profile and its ports, type the following command:

```
WX1200# display mobility-profile
Mobility Profiles
Name                Ports
=========================
roses-profile
                 AP 2
                 AP 3
                 AP 4
                 AP 6
```

To remove a Mobility Profile, type the following command:

```
clear mobility-profile name
```

Network User Configuration Scenarios

The following scenarios provide examples of ways in which you use AAA commands to configure access for users:

- "General Use of Network User Commands" on page 512
- "Enabling RADIUS Pass-Through Authentication" on page 514
- "Enabling PEAP-MS-CHAP-V2 Authentication" on page 514
- "Enabling PEAP-MS-CHAP-V2 Offload" on page 515
- "Combining EAP Offload with Pass-Through Authentication" on page 516
- "Overriding AAA-Assigned VLANs" on page 516

General Use of Network User Commands

The following example illustrates how to configure IEEE 802.1X network users for authentication, accounting, ACL filtering, and Mobility Profile assignment:

1. Configure all 802.1X users of SSID *mycorp* at EXAMPLE to be authenticated by server group *shorebirds.* Type the following command:

```
WX1200# set authentication dot1x ssid mycorp EXAMPLE\* pass-through shorebirds
```

2. Configure stop-only accounting for all *mycorp* users at EXAMPLE, for accounting records to be stored locally. Type the following command:

```
WX1200# set accounting dot1x ssid mycorp EXAMPLE\* stop-only local
success: change accepted.
```

3. Configure an ACL to filter the inbound packets for each user at EXAMPLE. Type the following command for *each* user: <<syntax valid?>>

```
WX1200# set user EXAMPLE\username attr filter-id = acl-101.in
```

This command applies the access list named *acl-101* to each user at EXAMPLE.

4. To display the ACL, type the following command:

```
WX1200# display security acl info acl-101
set security acl ip acl-101 (hits #0 0)
----------------------------------------------------
 1. permit IP source IP 192.168.1.1 0.0.0.255 destination IP any enable-hits
```

(For more information about ACLs, see Chapter 19, "Configuring and Managing Security ACLs," on page 377.)

5 Create a Mobility Profile called *tulip* by typing the following commands:

```
WX1200# set mobility-profile name tulip port 2,5
success: change accepted.
WX1200# set mobility-profile mode enable
success: change accepted.
WX1200# display mobility-profile
Mobility Profiles
Name                Ports
=========================
tulip
                 AP 2
                 AP 5
```

6 To assign Mobility Profile *tulip* to all users at EXAMPLE, type the following command for *each* EXAMPLE\ user:

```
WX1200# set user EXAMPLE\username attr mobility-profile tulip
```

Users at EXAMPLE are now restricted to ports 2 and 5, as specified in the *tulip* Mobility Profile configuration.

7 Use the **display aaa** command to verify your configuration. Type the following command:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=0 key=(null) author-pass=(null)
Radius Servers
Server                  Addr           Ports   T/o Tries Dead State
-------------------------------------------------------------------

Web Portal:
enabled

set accounting dot1x ssid mycorp EXAMPLE\* stop-only local
set authentication dot1x ssid mycorp EXAMPLE\* pass-through shorebirds
user tech
   Password = 1315021018 (encrypted)
user EXAMPLE/nin
   filter-id = acl.101.in
   mobility-profile = tulip
user EXAMPLE/tamara
   filter-id = acl.101.in
   mobility-profile = tulip
...
```

8 Save the configuration:

```
WX1200# save config
success: configuration saved.
```

Enabling RADIUS Pass-Through Authentication

The following example illustrates how to enable RADIUS pass-through authentication for all 802.1X network users:

1 Configure the RADIUS server *r1* at IP address 10.1.1.1 with the string *sunny* for the key. Type the following command:

```
WX1200# set radius server r1 address 10.1.1.1 key sunny
```

2 Configure the server group *sg1* with member *r1*. Type the following command:

```
WX1200# set server group sg1 members r1
```

3 Enable all 802.1X users of SSID *mycorp* to authenticate via pass-through to server group *sg1*. Type the following command:

```
WX1200# set authentication dot1x ssid mycorp *
pass-through sg1
```

4 Save the configuration:

```
WX1200# save config
success: configuration saved.
```

(For information about setting up RADIUS servers for remote authentication, see Chapter 22, “Configuring Communication with RADIUS,” on page 519.)

Enabling PEAP-MS-CHAP-V2 Authentication

The following example illustrates how to enable local PEAP-MS-CHAP-V2 authentication for all 802.1X network users. This example includes local usernames, passwords, and membership in a VLAN. This example includes one username and an optional attribute for a session-timeout in seconds.

1 To set authentication for all 802.1X users of SSID *thiscorp*, type the following command:

```
WX1200# set authentication dot1x ssid thiscorp * peap-mschapv2 local
```

2 To add user Natasha to the local database on the WX switch, type the following command:

```
WX1200# set user Natasha password moon
```

3. To assign Natasha to a VLAN named *red*, type the following command:

```
WX1200# set user Natasha attr vlan-name red
```

4. To assign Natasha a session timeout value of 1200 seconds, type the following command:

```
WX1200# set user Natasha attr session-timeout 1200
```

5. Save the configuration:

```
WX1200# save config
success: configuration saved.
```

Enabling PEAP-MS-CHAP-V2 Offload

The following example illustrates how to enable PEAP-MS-CHAP-V2 offload. In this example, all EAP processing is offloaded from the RADIUS server, but MS-CHAP-V2 authentication and authorization are done via a RADIUS server. The MS-CHAP-V2 lookup matches users against the user list on a RADIUS server.

1. Configure the RADIUS server *r1* at IP address 10.1.1.1 with the string *starry* for the key. Type the following command:

```
WX1200# set radius server r1 address 10.1.1.1 key starry
```

2. Configure the server group *sg1* with member *r1*. Type the following command:

```
WX1200# set server group sg1 members r1
```

3. Enable all 802.1X users of SSID *thiscorp* using PEAP-MS-CHAP-V2 to authenticate MS-CHAP-V2 on server group *sg1*. Type the following command:

```
WX1200# set authentication dot1x ssid thiscorp *
peap-mschapv2 sg1
```

4. Save the configuration:

```
WX1200 save config
success: configuration saved.
```

Combining EAP Offload with Pass-Through Authentication

The following example illustrates how to enable PEAP-MS-CHAP-V2 offload for the marketing (*mktg*) group and RADIUS pass-through authentication for members of engineering. This example assumes that engineering members are using DNS-style naming, such as is used with EAP-TLS. A WX server certificate is also required.

1. Configure the RADIUS server *r1* at IP address 10.1.1.1 with the string *starry* for the key. Type the following command:

```
WX1200# set radius server r1 address 10.1.1.1 key starry
```

2. Configure the server group *sg1* with member *r1*. Type the following command:

```
WX1200# set server group sg1 members r1
```

3. To authenticate all 802.1X users of SSID *bobblehead* in the group *mktg* using PEAP on the WX switch and MS-CHAP-V2 on server *sg1*, type the following command:

```
WX1200# set authentication dot1x ssid bobblehead mktg\* peap-mschapv2 sg1
```

4. To authenticate all 802.1X users of SSID *aircorp* in @eng.example.com via pass-through to *sg1*, type the following command:

```
WX1200# set authentication dot1x ssid aircorp *@eng.example.com pass-through sg1
```

5. Save the configuration:

```
WX1200# save config
success: configuration saved.
```

Overriding AAA-Assigned VLANs

The following example shows how to change the VLAN access of wireless users in an organization housed in multiple buildings.

Suppose the wireless users on the faculty of a college English department have offices in building A and are authorized to use that building's *bldga-prof-* VLANs. These users also teach classes in building B. Because you do not want to tunnel these users back to building A from building B when they use their wireless laptops in class, you configure the location policy on the WX switch to redirect them to the *bldgb-eng* VLAN.

You also want to allow writing instructors normally authorized to use any -*techcomm* VLAN in the college to access the network through the *bldgb-eng* VLAN when they are in building B.

1. Redirect *bldga-prof-* VLAN users to the VLAN *bldgb-eng*:

```
WX1200# set location policy permit vlan bldgb-eng if vlan eq bldga-prof-*
```

2. Allow writing instructors from *-techcomm* VLANs to use the *bldgb-eng* VLAN:

```
WX1200# set location policy permit vlan bldgb-eng if vlan eq *-techcomm
```

3. Display the configuration:

```
WX1200# display location policy
Id Clauses
-----------------------------------------------------
1) permit vlan bldgb-teach if vlan eq bldga-prof-*
2) permit vlan bldgb-eng if vlan eq *-techcomm
```

4. Save the configuration:

```
WX1200# save config
success: configuration saved.
```

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CONFIGURING COMMUNICATION WITH RADIUS

For a list of the standard and extended RADIUS attributes and 3Com vendor-specific attributes (VSAs) supported by MSS, see "Supported RADIUS Attributes" on page 651.

RADIUS Overview

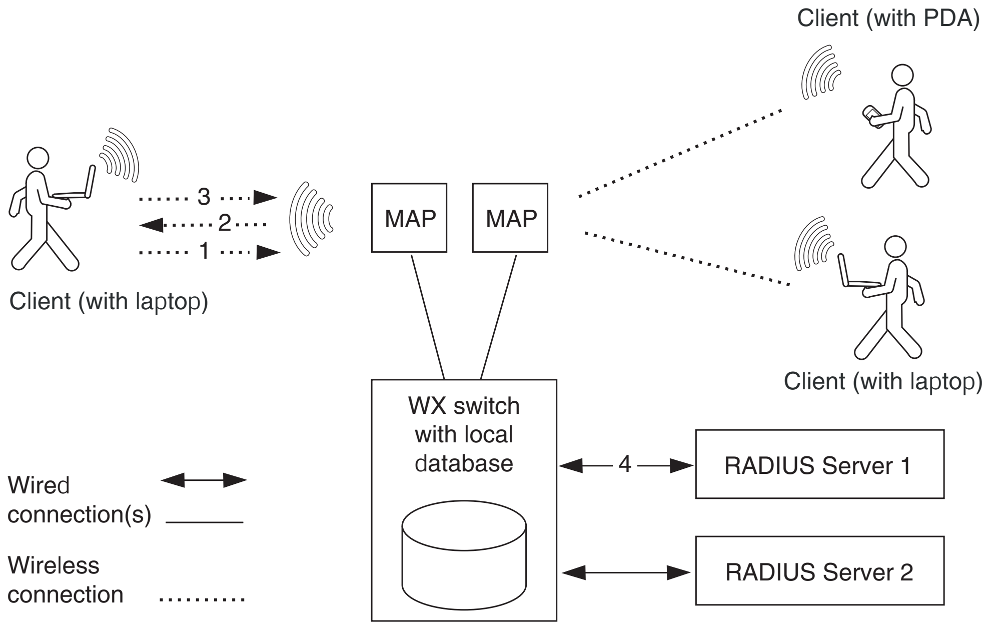
Remote Authentication Dial-In User Service (RADIUS) is a distributed client-server system. RADIUS servers provide a repository for all usernames and passwords, and can manage and store large groups of users.

RADIUS servers store user profiles, which include usernames, passwords, and other AAA attributes. You can use authorization attributes to authorize users for a type of service, for appropriate servers and network segments through VLAN assignments, for packet filtering by access control lists (ACLs), and for other services during a session.

You must include RADIUS servers in a server group before you can access them. (See "Configuring RADIUS Server Groups" on page 524.)

Figure 33 illustrates the interactions between wireless users (clients), MAPs, a WX switch, and its attached RADIUS servers when the clients attempt access.

Figure 33 Wireless Client, MAP, WX Switch, and RADIUS Servers


Client (with PDA)
3
2
1
MAP
MAP
Client (with laptop)
Client (with laptop)
WX switch with local database
4
RADIUS Server 1
RADIUS Server 2
Wired connection(s)
Wireless connection

In the example shown in Figure 33, the following events occur:

1. The wireless user (client) requests an IEEE 802.11 association from the MAP.
2. After the MAP creates the association, the WX switch sends an Extensible Authentication Protocol (EAP) identity request to the client.
3. The client sends an EAP identity response.
4. From the EAP response, the WX switch gets the client’s username. The WX switch then searches its AAA configuration, attempting to match the client's username against the user globs in the AAA configuration.

   When a match is found, the methods specified by the matching AAA command in the WX configuration file indicate how the client is to be authenticated, either locally on the WX switch, or via a RADIUS server group.
5. If the client does not support 802.1X, MSS attempts to perform MAC authentication for the client instead. In this case, if the switch’s configuration contains a **set authentication mac** command that matches the client’s MAC address, MSS uses the method specified by the command. Otherwise, MSS uses local MAC authentication by default.

   (For information about MAC client authentication, see “Configuring MAC Authentication and Authorization” on page 457.)

Before You Begin

To ensure that you can contact the RADIUS servers you plan to use for authentication, send the **ping** command to each one to verify connectivity.

```
ping ip-address
```

You can then set up communication between the WX switch and each RADIUS server group.

Configuring RADIUS Servers

An authentication server authenticates each client with access to a switch port before making available any services offered by the switch or the wireless network. The authentication server can reside either in the local database on the WX switch or on a remote RADIUS server.

When a RADIUS server is used for authentication, you must configure RADIUS server parameters. For each RADIUS server, you must, at a minimum, set the server name, the password (key), and the IP address. You can include any or all of the other optional parameters. You can set some parameters globally for the RADIUS servers.

For RADIUS servers that do not explicitly set their own dead time and timeout timers and transmission attempts, MSS sets the following values by default:

- **Dead time** — 0 (zero) minutes (The WX switch does not designate unresponsive RADIUS servers as unavailable.)
- **Transmission attempts** — 3
- **Timeout (WX wait for a server response)** — 5 seconds

When MSS sends an authentication or authorization request to a RADIUS server, MSS waits for the amount of the RADIUS timeout for the server to respond. If the server does not respond, MSS retransmits the request. MSS sends the request up to the number of retransmits configured. (The retransmit setting specifies the total number of attempts, including the first attempt.) For example, using the default values, MSS sends a request to a server up to three times, waiting 5 seconds between requests.

If a server does not respond before the last request attempt times out, MSS holds down further requests to the server, for the duration of the dead time. For example, if you set the dead time to 5 minutes, MSS stops sending requests to the unresponsive server for 5 minutes before reattempting to use the server.

During the holddown, it is as if the *dead* RADIUS server does not exist. MSS skips over any dead RADIUS servers to the next *live* server, or on to the next method if no more live servers are available, depending on your configuration. For example, if a RADIUS server group is the primary authentication method and **local** is the secondary method, MSS fails over to the local method if all RADIUS servers in the server group are unresponsive and have entered the dead time.

For failover authentication or authorization to work promptly, 3Com recommends that you change the dead time to a value other than 0. With the default setting, the dead time is never invoked and MSS does not hold down requests to unresponsive RADIUS servers. Instead, MSS attempts to send each new authentication or authorization request to a server even if the server is thought to be unresponsive. This behavior can cause authentication or authorization failures on clients because MSS does not fail over to the local method soon enough and the clients eventually time out.

Configuring Global RADIUS Defaults

You can change RADIUS values globally and set a global password (key) with the following command. The key *string* is the shared secret that the WX switch uses to authenticate itself to the RADIUS server.

```
set radius {deadtime minutes | encrypted-key string |
key string | retransmit number | timeout seconds}
```

(To override global settings for individual RADIUS servers, use the **set radius server** command. See “Configuring Individual RADIUS Servers” on page 523.)

For example, the following commands set the dead-time timer to 10 minutes and set the password to *r8gney* for all RADIUS servers in the WX configuration:

```
WX1200# set radius deadtime 10
success: change accepted.
WX1200# set radius key r8gney
success: change accepted.
```

To reset global RADIUS server settings to their factory defaults, use the following command:

```
clear radius {deadtime | key | retransmit | timeout}
```

For example, the following command resets the dead-time timer to 0 minutes on all RADIUS servers in the WX configuration:

```
WX1200# clear radius deadtime
success: change accepted.
```

Setting the System IP Address as the Source Address

By default, RADIUS packets leaving the WX switch have the source IP address of the outbound interface on the switch. This source address can change when routing conditions change. If you have set a system IP address for the WX switch, you can use it as a permanent source address for the RADIUS packets sent by the switch.

To set the WX system IP address as the address of the RADIUS client, type the following command:

```
WX1200# set radius client system-ip
success: change accepted.
```

To remove the WX switch's system IP address from use as the source address in RADIUS client requests from the switch to its RADIUS server(s), type the following command:

```
WX1200# clear radius client system-ip
success: change accepted.
```

The command causes the WX to select a source interface address based on information in its routing table as the RADIUS client address.

Configuring Individual RADIUS Servers

You must set up a name and IP address for each RADIUS server. To configure a RADIUS server, use the following command:

```
set radius server server-name [address ip-address]
[key string]
```

The server name must be unique for this RADIUS server on this WX switch. Do not use the same name for a RADIUS server and a RADIUS server group. The key (password) *string* is the shared secret that the WX switch uses to authenticate itself to the RADIUS server. (For additional options, see the *Wireless LAN Switch and Controller Command Reference*.)

For example, the following command names a RADIUS server *rs1* with the IP address 192.168.0.2 and the key *testing123*:

```
WX1200# set radius server rs1 address 192.168.0.2 key
testing123
success: change accepted.
```

You can configure multiple RADIUS servers. When you define server names and keys, case is significant. For example:

```
WX1200# set radius server rs1 address 10.6.7.8 key seCret
success: change accepted.
WX1200# set radius server rs2 address 10.6.7.9 key BigSecret
success: change accepted.
```

You must provide RADIUS servers with names that are unique. To prevent confusion, 3Com recommends that RADIUS server names differ in ways other than case. For example, avoid naming two servers RS1 and rs1.

You must configure RADIUS servers into server groups before you can access them. For information on creating server groups, see "Configuring RADIUS Server Groups" on page 524.

Deleting RADIUS Servers

To remove a RADIUS server from the WX configuration, use the following command:

```
clear radius server server-name
```

Configuring RADIUS Server Groups

A server group is a named group of up to four RADIUS servers. Before you can use a RADIUS server for authentication, you must first create a RADIUS server group and add the RADIUS server to that group. You can also arrange load balancing, so that authentications are spread out among servers in the group. You must declare *all* members of a server group, in contact order, when you create the group.

Once the group is configured, you can use a server group name as the AAA method with the **set authentication** and **set accounting** commands. (See Chapter 3, "Configuring AAA for Administrative and Local Access," on page 51 and Chapter 21, "Configuring AAA for Network Users," on page 433.)

Subsequently, you can change the members of a group or configure load balancing.

If you add or remove a RADIUS server in a server group, all the RADIUS dead timers for that server group are reset to the global default.

Creating Server Groups

To create a server group, you must first configure the RADIUS servers with their addresses and any optional parameters. After configuring RADIUS servers, type the following command:

```
set server group  group-name  members server-name1
[server-name2] [server-name3] [server-name4]
```

For example, to create a server group called *shorebirds* with the RADIUS servers *heron, egret*, and *sandpiper*, type the following commands:

```
WX1200# set radius server egret address 192.168.253.1 key apple
WX1200# set radius server heron address 192.168.253.2 key pear
WX1200# set radius server sandpiper address 192.168.253.3 key plum
WX1200# set server group shorebirds members egret heron sandpiper
```

In this example, a request to *shorebirds* results in the RADIUS servers being contacted in the order that they are listed in the server group configuration, first *egret*, then *heron*, then *sandpiper*. You can change the RADIUS servers in server groups at any time. (See "Adding Members to a Server Group" on page 527.)

Any RADIUS servers that do not respond are marked dead (unavailable) for a period of time. The unresponsive server is skipped over, as though it did not exist, during its dead time. Once the dead time elapses, the server is again a candidate for receiving requests. To change the default dead-time timer, use the ***set radius*** *or* ***set radius server*** *command.*

Ordering Server Groups

You can configure up to four methods for authentication, authorization, and accounting (AAA). AAA methods can be the local database on the WX switch and/or one or more RADIUS server groups. You set the order in which the WX switch attempts the AAA methods by the order in which you enter the methods in CLI commands.

In most cases, if the first method results in a pass or fail, the evaluation is final. If the first method does not respond or results in an error, the WX switch tries the second method and so on.

However, if the local database is the first method in the list, followed by a RADIUS server group, the WX switch responds to a failed search of the database by sending a request to the following RADIUS server group. This exception is called local override.

For more information, see "AAA Methods for IEEE 802.1X and Web Network Access" on page 442.

Configuring Load Balancing

You can configure the WX switch to distribute authentication requests across RADIUS servers in a server group, which is called load balancing. Distributing the authentication process across multiple RADIUS servers significantly reduces the load on individual servers while increasing resiliency on a systemwide basis.

When you configure load balancing, the first client's RADIUS requests are directed to the first server in the group, the second client's RADIUS requests are directed to the second server in the group, and so on. When the last server in the group is reached, the cycle is repeated.

MSS attempts to send accounting records to one RADIUS server, even if load balancing is configured.

To configure load balancing, use the following command:

```
set server group group-name load-balance enable
```

For example, to configure RADIUS servers *pelican* and *seagull* as the server group *swampbirds* with load balancing:

1. Configure the members of a server group by typing the following command:

```
WX1200# set server group swampbirds members pelican seagull
success: change accepted.
```

2. Enable load balancing by typing the following command:

```
WX1200# set server group swampbirds load-balance enable
success: change accepted.
```

The following command disables load balancing for a server group:

```
clear server group group-name load-balance
```

Adding Members to a Server Group

To add RADIUS servers to a server group, type the following command:

```
set server group group-name members
server-name1 [server-name2] [server-name3] [server-name4]
```

The keyword **members** lists the RADIUS servers contained in the named server group. A server group can contain between one and four RADIUS servers. This command accepts any RADIUS servers as the current set of servers. To change the server members, you must reenter all of them.

For example, to add RADIUS server *coot* to server group *shorebirds*:

1. Determine the server group by typing the following command:

```
WX1200# display aaa
Radius Servers
Server                   Addr           Ports    T/o Tries Dead State
----------------------------------------------------------------
sandpiper            192.168.253.3   1812 1813  5    3    0    UP
heron                192.168.253.1   1812 1813  5    3    0    UP
coot                 192.168.253.4   1812 1813  5    3    0    UP
egret                192.168.253.2   1812 1813  5    3    0    UP
Server groups
    shorebirds (load-balanced): sandpiper heron egret
```

The RADIUS server *coot* is configured but not part of the server group *shorebirds.*

2. To add RADIUS server *coot* as the last server in the server group *shorebirds*, type the following command:

```
WX1200# set server group shorebirds members sandpiper heron egret coot
success: change accepted.
```

Deleting a Server Group

To remove a server group, type the following command:

```
clear server group group-name
```

For example, to delete the server group *shorebirds*, type the following command:

```
WX1200# clear server group shorebirds
success: change accepted.
```

The members of the group remain configured, although no server groups are shown:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=0 key=(null) author-pass=(null)
Radius Servers
Server                  Addr           Ports    T/o Tries Dead State
-------------------------------------------------------------------
sandpiper            192.168.253.3   1812 1813  5    3    0    UP
heron                192.168.253.1   1812 1813  5    3    0    UP
coot                 192.168.253.4   1812 1813  5    3    0    UP
egret                192.168.253.2   1812 1813  5    3    0    UP
Server groups
```

RADIUS and Server Group Configuration Scenario

The following example illustrates how to declare four RADIUS servers to a WX switch and configure them into two load-balancing server groups, *swampbirds* and *shorebirds:*

1. Configure RADIUS servers. Type the following commands:

```
WX1200# set radius server pelican address 192.168.253.11 key elm
WX1200# set radius server seagull address 192.168.243.12 key fir
WX1200# set radius server egret address 192.168.243.15 key pine
WX1200# set radius server sandpiper address 192.168.253.17 key oak
```

2. Place two of the RADIUS servers into a server group called *swampbirds*. Type the following command:

```
WX1200# set server group swampbirds members pelican seagull
```

3. Enable load balancing for *swampbirds*. Type the following command:

```
WX1200# set server group swampbirds load-balance enable
```

4. Place the other RADIUS servers in a server group called *shorebirds*. Type the following command:

```
WX1200# set server group shorebirds members egret pelican
sandpiper
```

5. Enable load balancing for *shorebirds.* Type the following command:

```
WX1200# set server group shorebirds load-balance enable
```

6 Display the configuration. Type the following command:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=0 key=(null) author-pass=(null)
Radius Servers
Server                  Addr           Ports   T/o Tries Dead State
-------------------------------------------------------------------
sandpiper            192.168.253.17  1812 1813  5    3    0    UP
seagull              192.168.243.12  1812 1813  5    3    0    UP
egret                192.168.243.15  1812 1813  5    3    0    UP
pelican              192.168.253.11  1812 1813  5    3    0    UP
Server groups
    swampbirds (load-balanced): pelican seagull
    shorebirds (load-balanced): egret pelican sandpiper
```

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MANAGING 802.1X ON THE WX SWITCH

Certain settings for IEEE 802.1X sessions on the WX switch are enabled by default. For best results, change the settings only if you are aware of a problem with the WX switch's 802.1X performance. For settings that you can reset with a **clear** command, MSS reverts to the default value.

See "Managing WEP Keys" on page 534 for information about changing the settings for Wired-Equivalent Privacy protocol (WEP) key rotation (rekeying).

CAUTION: *802.1X parameter settings are global for all SSIDs configured on the WX switch.*

Managing 802.1X on Wired Authentication Ports

A wired authentication port is an Ethernet port that has 802.1X authentication enabled for access control. Like wireless users, users that are connected to a WX switch by Ethernet wire can be authenticated before they can be authorized to use the network. One difference between a wired authenticated user and a *wireless* authenticated user is that data for wired users is not encrypted after the users are authenticated.

By default, 802.1X authentication is enabled for wired authenticated ports, but you can disable it. You can also set the port to unconditionally authorize, or unconditionally reject, all users.

Enabling and Disabling 802.1X Globally

The following command globally enables or disables 802.1X authentication on all wired authentication ports on a WX switch:

```
set dot1x authcontrol {enable | disable}
```

The default setting is **enable**, which permits 802.1X authentication to occur as determined by the **set dot1X port-control** command for each wired authentication port. The **disable** setting forces all wired authentication ports to unconditionally authorize all 802.1X authentication attempts by users with an EAP success message.

To reenable 802.1X authentication on wired authentication ports, type the following command:

```
WX1200# set dot1x authcontrol enable
success: dot1x authcontrol enabled.
```

Setting 802.1X Port Control

The following command specifies the way a wired authentication port or group of ports handles user 802.1X authentication attempts:

```
set dot1x port-control
{forceauth | forceunauth | auto} port-list
```

The default setting is **auto**, which allows the WX switch to process 802.1X authentication normally according to the authentication configuration. Alternatively, you can set a wired authentication port or ports to either unconditionally authenticate or unconditionally reject all users.

For example, the following command forces port 1 to unconditionally authenticate all 802.1X authentication attempts with an EAP success message:

```
WX1200# set dot1x port-control forceauth 1
success: authcontrol for 1 is set to FORCE-AUTH.
```

Similarly, the following command forces port 2 to unconditionally reject any 802.1X attempts with an EAP failure message:

```
WX1200# set dot1x port-control forceunauth 2
success: authcontrol for 2 is set to FORCE-UNAUTH.
```

The **set dot1x port-control** command is overridden by the **set dot1x authcontrol** command. The **clear dot1x port-control** command returns port control to the default **auto** value.

Type the following command to reset port control for all wired authentication ports:

```
WX1200# clear dot1x port-control
success: change accepted.
```

Managing 802.1X Encryption Keys

By default, the WX switch sends encryption key information to a wireless supplicant (client) in an Extensible Authentication Protocol over LAN (EAPoL) packet after authentication is successful. You can disable this feature or change the time interval for key transmission.

The secret Wired-Equivalent Privacy protocol (WEP) keys used by MSS on MAPs for broadcast communication on a VLAN are automatically rotated (rekeyed) every 30 minutes to maintain secure packet transmission. You can disable WEP key rotation for debugging purposes, or change the rotation interval.

Enabling 802.1X Key Transmission

The following command enables or disables the transmission of key information to the supplicant (client) in EAPoL key messages, after authentication:

```
set dot1x key-tx {enable | disable}
```

Key transmission is enabled by default.

The WX switch sends EAPoL key messages after successfully authenticating the supplicant (client) and receiving authorization attributes for the client. If the client is using dynamic WEP, the EAPoL Key messages are sent immediately after authorization.

Type the following command to reenable key transmission:

```
WX1200# set dot1x key-tx enable
success: dot1x key transmission enabled.
```

Configuring 802.1X Key Transmission Time Intervals

The following command sets the number of seconds the WX switch waits before retransmitting an EAPoL packet of key information:

```
set dot1x tx-period seconds
```

The default is 5 seconds. The range for the retransmission interval is from 1 to 65,535 seconds. For example, type the following command to set the retransmission interval to 300 seconds:

```
WX1200# set dot1x tx-period 300
success: dot1x tx-period set to 300.
```

Type the following command to reset the retransmission interval to the 5-second default:

```
WX1200# clear dot1x tx-period
success: change accepted.
```

Managing WEP Keys

Wired-Equivalent Privacy (WEP) is part of the system security of 802.1X. MSS uses WEP to provide confidentiality to packets as they are sent over the air. WEP operates on the MAP.

WEP uses a secret key shared between the communicators. WEP rekeying increases the security of the network. New unicast keys are generated every time a client performs 802.1X authentication.

The rekeying process can be performed automatically on a periodic basis. By setting the Session-Timeout RADIUS attribute, you make the reauthentication transparent to the client, who is unaware that reauthentication is occurring. A good value for Session-Timeout is 30 minutes.

WEP broadcast rekeying causes the broadcast and multicast keys for WEP to be rotated every WEP rekey period for each radio to each connected VLAN. The WX switch generates the new broadcast and multicast keys and pushes the keys to the clients via EAPoL key messages. WEP keys are case-insensitive.

Use the **set dot1x wep-rekey** and the **set dot1x wep-rekey-period** commands to enable WEP key rotation and configure the time interval for WEP key rotation.

Configuring 802.1X WEP Rekeying

WEP rekeying is enabled by default on the WX switch. Disable WEP rekeying only if you need to debug your 802.1X network.

Use the following command to disable WEP rekeying for broadcast and multicast keys:

```
WX1200# set dot1x wep-rekey disable
success: wep rekeying disabled
```

Reauthentication is not required for using this command. Broadcast and multicast keys are always rotated at the same time, so all members of a given radio and VLAN receive the new keys at the same time.

To reenable WEP rekeying, type the following command:

```
WX1200# set dot1x wep-rekey enable
success: wep rekeying enabled
```

Configuring the Interval for WEP Rekeying

The following command sets the interval for rotating the WEP broadcast and multicast keys:

```
set dot1x wep-rekey-period seconds
```

The default is 1800 seconds (30 minutes). You can set the interval from 30 to 1,641,600 seconds (19 days). For example, type the following command to set the WEP-rekey period to 900 seconds:

```
WX1200# set dot1x wep-rekey-period 900
success: dot1x wep-rekey-period set to 900
```

Setting EAP Retransmission Attempts

The following command sets the maximum number of times the WX switch retransmits an 802.1X-encapsulated EAP request to the supplicant (client) before it times out the authentication session:

```
set dot1x max-req number-of-retransmissions
```

The default number of retransmissions is 2. You can specify from 0 to 10 retransmit attempts. For example, type the following command to set the maximum number of retransmission attempts to 3:

```
WX1200# set dot1x max-req 3
success: dot1x max request set to 3.
```

To reset the number of retransmission attempts to the default setting, type the following command:

```
WX1200# clear dot1x max-req
success: change accepted.
```

To support SSIDs that have both 802.1X and static WEP clients, MSS sends a maximum of two ID requests, even if this parameter is set to a higher value. Setting the parameter to a higher value does affect all other types of EAP messages.

The amount of time MSS waits before it retransmits an 802.1X-encapsulated EAP request to the supplicant is the same number of seconds as one of the following timeouts:

- Supplicant timeout (configured by the **set dot1x timeout supplicant** command)
- RADIUS session-timeout attribute

If both of these timeouts are set, MSS uses the shorter of the two. If the RADIUS session-timeout attribute is not set, MSS uses the timeout specified by the **set dot1x timeout supplicant** command, by default 30 seconds.

Managing 802.1X Client Reauthentication

Reauthentication of 802.1X wireless supplicants (clients) is enabled on the WX switch by default. By default, the WX switch waits 3600 seconds (1 hour) between authentication attempts. You can disable reauthentication or change the defaults.

You also can use the RADIUS session-timeout attribute to set the reauthentication timeout for a specific client. In this case, MSS uses the timeout that has the lower value. If the session-timeout is set to fewer seconds than the global reauthentication timeout, MSS uses the session-timeout for the client. However, if the global reauthentication timeout is shorter than the session-timeout, MSS uses the global timeout instead.

Enabling and Disabling 802.1X Reauthentication

The following command enables or disables the reauthentication of supplicants (clients) by the WX switch:

```
set dot1x reauth {enable | disable}
```

Reauthentication is enabled by default.

Type the following command to reenable reauthentication of clients:

```
WX1200# set dot1x reauth enable
success: dot1x reauthentication enabled.
```

Setting the Maximum Number of 802.1X Reauthentication Attempts

The following command sets the number of reauthentication attempts that the WX switch makes before the supplicant (client) becomes unauthorized:

```
set dot1x reauth-max number-of-attempts
```

The default number of reauthentication attempts is 2. You can specify from 1 to 10 attempts. For example, type the following command to set the number of authentication attempts to 8:

```
WX1200# set dot1x reauth-max 8
success: dot1x max reauth set to 8.
```

Type the following command to reset the maximum number of reauthorization attempts to the default:

```
WX1200# clear dot1x reauth-max
success: change accepted.
```

If the number of reauthentications for a wired authentication client is greater than the maximum number of reauthentications allowed, MSS sends an EAP failure packet to the client and removes the client from the network. However, MSS does not remove a wireless client from the network under these circumstances.

Setting the 802.1X Reauthentication Period

The following command configures the number of seconds that the WX switch waits before attempting reauthentication:

```
set dot1x reauth-period seconds
```

The default is 3600 seconds (1 hour). The range is from 60 to 1,641,600 seconds (19 days). This value can be overridden by user authorization parameters.

MSS reauthenticates dynamic WEP clients based on the reauthentication timer. MSS also reauthenticates WPA clients if the clients use the WEP-40 or WEP-104 cipher. For each dynamic WEP client or WPA client using a WEP cipher, the reauthentication timer is set to the lesser of the global setting or the value returned by the AAA server with the rest of the authorization attributes for that client.

For example, type the following command to set the number of seconds to 100 before reauthentication is attempted:

```
WX1200# set dot1x reauth-period 100
success: dot1x auth-server timeout set to 100.
```

Type the following command to reset the default timeout period:

```
WX1200# clear dot1x reauth-period
success: change accepted.
```

Setting the Bonded Authentication Period

The following command changes the Bonded Auth™ (bonded authentication) period, which is the number of seconds MSS retains session information for an authenticated machine while waiting for the 802.1X client on the machine to start (re)authentication for the user.

Normally, the Bonded Auth period needs to be set only if the network has Bonded Auth clients that use dynamic WEP, or use WEP-40 or WEP-104 encryption with WPA or RSN. These clients can be affected by the 802.1X reauthentication parameter or the RADIUS Session-Timeout parameter.

To set the Bonded Auth period, use the following command:

```
set dot1x bonded-period seconds
```

The Bonded Auth period applies only to 802.1X authentication rules that contain the **bonded** option.

To reset the Bonded Auth period to its default value, use the following command:

```
clear dot1x max-req
```

(For more information about Bonded Auth, see “Binding User Authentication to Machine Authentication” on page 451.)

Managing Other Timers

By default, the WX switch waits 60 seconds before responding to a client whose authentication failed, and times out a request to a RADIUS server or an authentication session with a client after 30 seconds. You can modify these defaults.

Setting the 802.1X Quiet Period

The following command configures the number of seconds a WX switch remains quiet and does not respond to a supplicant (client) after a failed authentication:

```
set dot1x quiet-period seconds
```

The default is 60 seconds. The acceptable range is from 0 to 65,535 seconds.

For example, type the following command to set the quiet period to 300 seconds:

```
WX1200# set dot1x quiet-period 300
success: dot1x quiet period set to 300.
```

Type the following command to reset the 802.1X quiet period to the default:

```
WX1200# clear dot1x quiet-period
success: change accepted.
```

Setting the 802.1X Timeout for an Authorization Server

Use this command to configure the number of seconds before the WX switch times out a request to a RADIUS authorization server.

```
set dot1x timeout auth-server seconds
```

The default is 30 seconds. The range is from 1 to 65,535 seconds.

For example, type the following command to set the authorization server timeout to 60 seconds:

```
WX1200# set dot1x timeout auth-server 60
success: dot1x auth-server timeout set to 60.
```

To reset the 802.1X authorization server timeout to the default, type the following command:

```
WX1200# clear dot1x timeout auth-server
success: change accepted.
```

Setting the 802.1X Timeout for a Client

Use the following command to set the number of seconds before the WX switch times out an authentication session with a supplicant (client):

```
set dot1x timeout supplicant seconds
```

The default is 30 seconds. The range of time is from 1 to 65,535 seconds.

For example, type the following command to set the number of seconds for a timeout to 300:

```
WX1200# set dot1x timeout supplicant 300
success: dot1x supplicant timeout set to 300.
```

Type the following command to reset the timeout period:

```
WX1200# clear dot1x timeout supplicant
success: change accepted.
```

Displaying 802.1X Information

This command displays 802.1X information for clients, statistics, VLANs, and configuration.

```
display dot1x {clients | stats | config}
```

- **display dot1x clients** displays the username, MAC address, VLAN, and state of active 802.1X clients.
- **display dot1x config** displays a summary of the current configuration.
- **display dot1x stats** displays global 802.1X statistical information associated with connecting and authenticating.

Viewing 802.1X Clients

Type the following command to display active 802.1X clients:

```
WX1200# display dot1x clients
MAC Address               State         Vlan            Identity
-------------            -------       ------          ----------
00:20:a6:48:01:1f       Connecting     (unknown)
00:05:3c:07:6d:7c       Authenticated  vlan-it         EXAMPLE\smith
00:05:5d:7e:94:83       Authenticated  vlan-eng        EXAMPLE\jgarcia
00:02:2d:86:bd:38       Authenticated  vlan-eng        wong@exmpl.com
00:05:5d:7e:97:b4       Authenticated  vlan-eng        EXAMPLE\hosni
00:05:5d:7e:98:1a       Authenticated  vlan-eng        EXAMPLE\tsmith
00:0b:be:a9:dc:4e       Authenticated  vlan-pm         havel@corp.com
00:05:5d:7e:96:e3       Authenticated  vlan-eng        EXAMPLE\geetha
00:02:2d:6f:44:77       Authenticated  vlan-eng        EXAMPLE\tamara
00:05:5d:7e:94:89       Authenticated  vlan-eng        EXAMPLE\nwong
00:06:80:00:5c:02       Authenticated  vlan-eng        EXAMPLE\hhabib
00:02:2d:6a:de:f2       Authenticated  vlan-pm         smith@exmpl.com
00:02:2d:5e:5b:76       Authenticated  vlan-pm         EXAMPLE\natasha
00:02:2d:80:b6:e1       Authenticated  vlan-cs         jjg@exmpl.com
00:30:65:16:8d:69       Authenticated  vlan-wep        MAC authenticated
00:02:2d:64:8e:1b       Authenticated  vlan-eng        EXAMPLE\jose
```

Viewing the 802.1X Configuration

Type the following command to display the 802.1X configuration:

```
WX1200# display dot1x config

        802.1X user policy
        ----------------------
'EXAMPLE\pc1' on ssid 'mycorp' doing EAP-PEAP (EAP-MSCHAPv2)
'EXAMPLE\bob' on ssid 'mycorp' doing EAP-PEAP (EAP-MSCHAPv2)
(bonded)
```

```
802.1X parameter                setting
----------------                -------
supplicant timeout              30
auth-server timeout             30
quiet period                    5
transmit period                 5
reauthentication period         3600
maximum requests                2
key transmission                enabled
reauthentication                enabled
authentication control          enabled
WEP rekey period                1800
WEP rekey                       enabled
Bonded period                   60

port 5, authcontrol: auto, max-sessions: 16
port 6, authcontrol: auto, max-sessions: 1
```

Viewing 802.1X Statistics

Type the following command to display 802.1X statistics about connecting and authenticating:

```
WX1200# display dot1x stats
        802.1X statistic                value
        ----------------                -----
        Enters Connecting:              709
        Logoffs While Connecting:       112
        Enters Authenticating:          467
        Success While Authenticating:   0
        Timeouts While Authenticating:  52
        Failures While Authenticating:  0
        Reauths While Authenticating:   0
        Starts While Authenticating:    31
        Logoffs While Authenticating:   0
        Starts While Authenticated:     85
        Logoffs While Authenticated:    1
        Bad Packets Received:           0
```

For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.

24

CONFIGURING SODA ENDPOINT SECURITY FOR A WX SWITCH

Sygate On-Demand (SODA) is an endpoint security solution that allows enterprises to enforce security policies on client devices without having to install any special software on the client machines. MSS can be configured to run SODA security checks on users' machines as a requirement for gaining access to the network.

About SODA Endpoint Security

The SODA endpoint security solution consists of six modules that provide on-demand security:

- **Virtual Desktop** – Protects confidential data by virtualizing the desktop, applications, file-system, registry, printing, removable media, and copy/paste functions. All data is encrypted on-the-fly and can optionally be erased upon session termination. The virtual desktop is isolated from the normal desktop, protecting the session from previous infection.
- **Host Integrity** – Tests the security of the desktop to determine how much access to network resources the device should be granted. Host integrity checks include:
  - Ensuring that an anti-virus product is running with up-to-date virus definitions
  - Ensuring that a personal firewall is active
  - Checking that service pack levels are met
  - Ensuring that critical patches are installed

  Custom checks can be implemented based on the existence of specific registry keys/values, applications, files, or operating system platforms. Network access can also be prevented based on the existence of specific processes.

- **Malicious Code Protection** – Detects and blocks keystroke loggers that capture usernames and passwords, Trojans that create back-door user accounts, and Screen Scrapers that spy on user activity.

  The Malicious Code module integrates a Virtual Keyboard function that requires users to input confidential information such as passwords using the Virtual Keyboard when accessing specific Web sites, to protect against hardware keystroke loggers. This module uses a combination of signatures for known exploits and behavioral detection to protect against unknown threats.
- **Cache Cleaner** – Ensures that Web browser information, such as cookies, history, auto-completion data, stored passwords, and temporary files are erased or removed upon termination of the user's session, inactivity timeout, or closing of the browser.
- **Connection Control** – Controls network connections based on Domain, IP address, Port, and Service. For example, Connection Control can prevent a Trojan from sending out a confidential document, downloaded legitimately through an SSL VPN tunnel, to a malicious e-mail server (SMTP) using a second network tunnel.
- **Adaptive Policies** – Sense the type and location of device and adjusts access based on endpoint parameters such as IP range, registry keys, and DNS settings

  The SODA endpoint security modules are configured through *Sygate On-Demand Manager* (SODA Manager), a Windows application. SODA Manager is used to create a *SODA agent*, which is a Java applet that is downloaded by client devices when they attempt to gain access to the network. Once downloaded, the SODA agent runs a series of security checks to enforce endpoint security on the client device.

SODA Endpoint Security Support on WX Switches

WX switches support SODA endpoint security functionality in the following ways:

- SODA agent applets can be uploaded to a WX switch, stored there, and downloaded by clients attempting to connect to the network.
- The WX switch can ensure that clients run the SODA agent security checks successfully prior to allowing them access to the network.
- Different sets of security checks can be downloaded and run, based on the SSID being used by the client.

- If the security checks fail, the WX switch can deny the client access to the network, or grant the client limited access based on a configured security ACL.
- When the client closes the Virtual Desktop, the WX switch can optionally disconnect the client from the network.

How SODA Functionality Works on WX Switches

This section describes how the SODA functionality is configured to work with a WX switch, and the procedure that takes place when a user attempts to connect to an SSID where the SODA functionality is enabled.

Note that in the current release, the SODA functionality works only in conjunction with the Web Portal WebAAA feature.

SODA functionality on a WX switch is configured as follows:

1. Using SODA Manager, a network administrator creates a SODA agent based on the security needs of the network.
2. The network administrator exports the SODA agent files from SODA Manager, and saves them as a .zip file.
3. The SODA agent .zip file is uploaded to the WX switch using TFTP.
4. The SODA agent files are installed on the WX switch using a CLI command that extracts the files from the .zip file and places them into a specified directory.
5. SODA functionality is enabled for an SSID that also has Web Portal WebAAA configured.

Once configured, SODA functionality works as follows:

1. A user connects to a MAP managed by a service profile where SODA functionality is enabled.
2. Since the Web Portal WebAAA feature is enabled for the SSID, a portal session is started for the user, and the user is placed in the VLAN associated with the **web-portal-*ssid*** or **web-portal-wired** user.
3. The user opens a browser window and is redirected to a login page, where he or she enters a username and password.
4. The user is redirected to a page called *index.html*, which exists in the SODA agent directory on the WX switch.
5. The redirection to the *index.html* page causes the SODA agent files to be downloaded to the user’s computer.

6. Once the SODA agent files have been downloaded, one of the following can take place:
   - **a** If the WX switch is configured to enforce the SODA agent security checks (the default), then the SODA agent checks are run on the user's computer. If the user's computer passes the checks, then a customizable *success page* is loaded in the browser window. The user is then moved from the portal VLAN to his or her configured VLAN and granted access to the network.
   - **b** If the WX switch is configured ***not*** to enforce the SODA agent security checks, then the user is moved from the portal VLAN to his or her configured VLAN and granted access to the network, without waiting for the SODA agent checks to be completed.
   - **c** If the user's computer fails one of the SODA agent checks, then a customizable *failure page* is loaded in the browser window. The user is then disconnected from the network, or can optionally be granted limited network access, based on a specified security ACL.
7. At the completion of his or her session, the user can close the SODA Virtual Desktop or point to an advertised logout URL. Either of these actions cause a customizable *logout page* to be loaded in the browser window. Accessing the logout page causes the user to be disconnected from the network.

Configuring SODA Functionality

Configuring SODA functionality on a WX switch consists of the following tasks:

1. Configure Web Portal WebAAA for the service profile. See "Configuring Web Portal WebAAA for the Service Profile" on page 547.
2. Using SODA manager, create the SODA agent. See "Creating the SODA Agent with SODA Manager" on page 547.
3. Copy the SODA agent to the WX switch. See "Copying the SODA Agent to the WX Switch" on page 549.
4. Install the SODA agent files in a directory on the WX switch. See "Installing the SODA Agent Files on the WX Switch" on page 549.
5. Enable SODA functionality for the service profile. See "Enabling SODA Functionality for the Service Profile" on page 550.
6. Specify whether to require clients to pass SODA agent checks to gain access to the network (optional). See "Disabling Enforcement of SODA Agent Checks" on page 550.

7 Specify a page for a client to load when the SODA agent checks run successfully (optional). See "Specifying a SODA Agent Success Page" on page 551.

8 Specify a page for a client to load when the SODA agent checks fail (optional). See "Specifying a SODA Agent Failure Page" on page 551.

9 Specify an ACL to apply to a client when it fails the SODA agent checks (optional) See "Specifying a Remediation ACL" on page 552.

10 Specify a page for a client to load when logging out of the network (optional). See "Specifying a SODA Agent Logout Page" on page 553.

11 Specify an alternate name for the directory where the SODA agent files for a service profile are located (optional). See "Specifying an Alternate SODA Agent Directory for a Service Profile" on page 554.

12 Remove the SODA agent files from the WX switch (optional). See "Uninstalling the SODA Agent Files from the WX Switch" on page 554.

Configuring Web Portal WebAAA for the Service Profile

In the current release, SODA functionality works in conjunction with the Web Portal AAA feature. Consequently, Web Portal AAA must be enabled for the service profile for which you want to configure SODA functionality.

See "Configuring Web Portal WebAAA" on page 460 for information on configuring this feature.

Creating the SODA Agent with SODA Manager

Sygate On-Demand Manager (SODA Manager) is a Windows application used for configuring security policies based on *locations*, and for creating *agents* that enforce those security policies. For information on how to use SODA Manager to create security policies, see the documentation that came with the product.

You can use SODA Manager to create a SODA agent, configuring the level of security desired according to the requirements of your network. When a SODA agent is created (by pressing the **Apply** button in SODA Manager), a subdirectory called *On-DemandAgent* is created in the *C:\Program Files\Sygate\Sygate On-Demand* directory.

You place the contents of the *On-DemandAgent* directory into a .zip file (for example, *soda.ZIP)* and copy the file to the WX switch using TFTP, as described in "Copying the SODA Agent to the WX Switch" on page 549.

Note the following when creating the SODA agent in SODA Manager:

- The *failure.html* and *success.html* pages, when specified as success or failure URLs in SODA Manager, *must* be of the format:

  `https://hostname/soda/ssid/xxx.html`

  where *xxx* refers to the name of the HTML file being accessed.

- The success and failure URLs configured in SODA Manager are required to have two keywords in them: */soda/* and *success.html* or *failure.html*. The /soda/ keyword must immediately follow the hostname. The *hostname* must match the Common Name specified in the WebAAA certificate.

- The logout page is required to have */logout.html* in the URL.

- The hostname of the logout page should be set to a name that resolves to the WX switch's IP address on the VLAN where the client resides, or should be the IP address of the WX switch on the Web Portal WebAAA VLAN; for example:

  `https://10.1.1.1/logout.html`

  The logout page should not point to a certificate hostname that is unreachable from the client's VLAN, nor should it point to an IP address that is on a different VLAN, which causes the source MAC address to be changed to the default router's (gateway's) MAC address. The WX switch uses the client's source MAC address and source IP address combination to make sure the client is permitted to log itself out.

  If the source IP address is on a different VLAN, then the source MAC address does not match with the session's MAC address, and the logout procedure fails.

- Following the hostname, the URL of the logout page must exactly match *logout.html*. You cannot specify any other subdirectories in the URL.

- Do not use the **Partner Integration** button in SODA Manager to create agent files.

Copying the SODA Agent to the WX Switch

After creating the SODA agent with SODA manager, you copy the .zip file to the WX switch using TFTP.

For example, the following command copies the *soda.ZIP* file from a TFTP server to the WX switch:

```
WX1200# copy tftp://172.21.12.247/soda.ZIP soda.ZIP
....................................success: received
2912917 bytes in
 11.230 seconds [ 259387 bytes/sec]

success: copy complete.
```

Installing the SODA Agent Files on the WX Switch

After copying the .zip file containing the SODA agent files to the WX switch, you install the SODA agent files into a directory using the following command:

```
install soda agent agent-file agent-directory directory
```

This command creates the specified *directory*, unzips the specified *agent-file* and places the contents of the file into the directory. If the directory has the same name as an SSID, then that SSID uses the SODA agent files in the directory if SODA functionality is enabled for the service profile that manages the SSID.

For example, the following command installs the contents of the file *soda.ZIP* into a directory called *sp1*.

```
WX1200# install soda agent soda.ZIP agent-directory sp1
This command may take up to 20 seconds...
WX1200#
```

If SODA functionality is enabled for the service profile that manages SSID sp1, then SODA agent files in this directory are downloaded to clients attempting to connect to SSID sp1.

Enabling SODA Functionality for the Service Profile

To enable SODA functionality for a service profile, use the following command:

```
set service-profile name soda mode {enable | disable}
```

When SODA functionality is enabled for a service profile, a SODA agent is downloaded to clients attempting to connect to a MAP managed by the service profile. The SODA agent performs a series of security-related checks on the client. By default, enforcement of SODA agent checks is enabled, so that a connecting client must pass the SODA agent checks in order to gain access to the network.

For example, the following command enables SODA functionality for service profile *sp1*:

```
WX1200# set service-profile sp1 soda mode enable
success: change accepted.
```

Disabling Enforcement of SODA Agent Checks

When SODA functionality is enabled for a service profile, by default the SODA agent checks are downloaded to a client and run before the client is allowed on the network. You can optionally disable the enforcement of the SODA security checks, so that the client is allowed access to the network immediately after the SODA agent is downloaded, rather than waiting for the security checks to be run.

To disable (or re-enable) the enforcement of the SODA security checks, use the following command:

```
set service-profile name enforce-checks {enable | disable}
```

For example, the following command disables the enforcement of the SODA security checks, allowing network access to clients after they have downloaded the SODA agent, but without requiring that the SODA agent checks be completed:

```
WX1200# set service-profile sp1 enforce-checks disable
success: change accepted.
```

Note that if you disable the enforcement of the SODA security checks, you cannot apply the success and failure URLs to client devices. In addition, you should not configure the SODA agent to refer to the success and failure pages on the WX switch if you have disabled enforcement of SODA agent checks.

Specifying a SODA Agent Success Page

When a client successfully runs the checks performed by the SODA agent, by default a dynamically generated page is displayed on the client indicating that the checks succeeded. You can optionally create a custom success page that is displayed on the client instead of the dynamically generated one.

To specify a page that is loaded when a client passes the security checks performed by the SODA agent, use the following command:

```
set service-profile name soda success-page page
```

To reset the success page to the default value, use the following command:

```
clear service-profile name soda success-page
```

The *page* refers to a file on the WX switch. After this page is loaded, the client is placed in its assigned VLAN and granted access to the network.

For example, the following command specifies *success.html*, which is a file in the root directory on the WX switch, as the page to load when a client passes the SODA agent checks:

```
WX1200# set service-profile sp1 soda success-page
success.html
success: change accepted.
```

The following command specifies *success.html*, in the *soda-files* directory on the WX switch, as the page to load when a client passes the SODA agent checks:

```
WX1200# set service-profile sp1 soda success-page
soda-files/success.html
success: change accepted.
```

Specifying a SODA Agent Failure Page

When the SODA agent checks fail, by default a dynamically generated page is displayed on the client indicating that the checks failed. You can optionally create a custom failure page that is displayed on the client instead of the dynamically generated one.

To specify a page that is loaded when a client fails the security checks performed by the SODA agent, use the following command:

```
set service-profile name soda failure-page page
```

To reset the failure page to the default value, use the following command:

```
clear service-profile name soda failure-page
```

The *page* refers to a file on the WX switch. After this page is loaded, the specified remediation ACL takes effect, or if there is no remediation ACL configured, then the client is disconnected from the network.

For example, the following command specifies *failure.html,* which is a file in the root directory on the WX switch, as the page to load when a client fails the SODA agent checks:

```
WX1200# set service-profile sp1 soda failure-page
failure.html
success: change accepted.
```

The following command specifies *failure.html,* in the *soda-files* directory on the WX switch, as the page to load when a client fails the SODA agent checks:

```
WX1200# set service-profile sp1 soda failure-page
soda-files/failure.html
success: change accepted.
```

Specifying a Remediation ACL

If the SODA agent checks fail on a client, by default the client is disconnected from the network. Optionally, you can specify a failure page for the client to load (with the **set service-profile soda failure-page** command, described above). You can optionally specify a *remediation ACL* to apply to the client when the failure page is loaded. The remediation ACL can be used to grant the client limited access to network resources, for example:

To specify a remediation ACL to be applied to a client if it fails the checks performed by the SODA agent, use the following command:

```
set service-profile name soda remediation-acl acl-name
```

To disable use of the remediation ACL for the service profile, use the following command:

```
clear service-profile name soda remediation-acl
```

The *acl-name* refers to an existing security ACL. If there is no remediation ACL configured for the service profile, then the client is disconnected from the network when the failure page is loaded.

If configured, a remediation ACL is applied to a client when the client loads the failure page. A client loads the failure page only if the service profile is set to enforce SODA agent checks, and the client fails the SODA agent checks. Consequently, in order to apply a remediation ACL to a client, you must make sure the service profile is set to enforce SODA agent checks.

For example, the following command configures the WX switch to apply *acl-1* to a client when it loads the failure page:

```
WX1200# set service-profile sp1 soda remediation-acl acl-1
success: change accepted.
```

Specifying a SODA Agent Logout Page

When a client closes the SODA virtual desktop, the client is automatically disconnected from the network. You can optionally specify a page that is loaded when the client logs out of the network. To do this, use the following command:

```
set service-profile name soda logout-page page
```

To reset the logout page to the default value, use the following command:

```
clear service-profile name soda logout-page
```

The *page* refers to a file on the WX switch.

For the logout page to load properly, you must enable the HTTPS server on the WX switch, so that clients can access the page using HTTPS. To do this, use the following command:

```
set ip https server enable
```

The client can request this page at any time, to ensure that the client's session has been terminated. You can add the IP address of the WX switch to the DNS server as a well-known name, and you can advertise the URL of the page to users as a logout page.

For example, the following command specifies *logout.html,* which is a file in the root directory on the WX switch, as the page to load when a client closes the SODA virtual desktop:

```
WX1200# set service-profile sp1 soda logout-page logout.html
success: change accepted.
```

The following command specifies *logout.html,* in the *soda-files* directory on the WX switch, as the page to load when a client closes the SODA virtual desktop:

```
WX# set service-profile sp1 soda logout-page
soda-files/logout.html
success: change accepted.
```

During authentication, a pop-under window appears behind the client's browser. The window contains a button labeled "End Session". The client can click this button to terminate the session.

Specifying an Alternate SODA Agent Directory for a Service Profile

By default, the WX switch expects SODA agent files for a service profile to be located in a directory with the same name as the SSID configured for the service profile. You can optionally specify a different directory for the SODA agent files used for a service profile. To do this, use the following command:

```
set service-profile name soda agent-directory directory
```

To reset the SODA agent directory to the default value, use the following command:

```
clear service-profile name soda agent-directory
```

If the same SODA agent is used for multiple service profiles, you can specify a single directory for SODA agent files on the WX switch, rather than placing the same SODA agent files in a separate directory for each service profile.

For example, the following command specifies *soda-agent* as the location for SODA agent files for service profile sp1:

```
WX1200# set service-profile sp1 soda agent-directory
soda-agent
success: change accepted.
```

Uninstalling the SODA Agent Files from the WX Switch

To remove the directory on the WX switch that contains SODA agent files, use the following command:

```
uninstall soda agent agent-directory directory
```

This command removes the SODA agent directory and all of its contents. All files in the specified directory are removed. The command removes the directory and its contents, regardless of whether it contains SODA agent files.

For example, the following command removes the directory *sp1* and all of its contents:

```
WX1200# uninstall soda agent agent-directory sp1
This will delete all files in agent-directory, do you wish to
continue? (y|n) [n]y
```

Displaying SODA Configuration Information

To view information about the SODA configuration for a service profile, use the **display service profile** command.

The following is an example of the output of the **display service profile** command for service profile sp1. In the example, the fields related to SODA functionality are highlighted in bold.

```
WX1200# display service-profile sp1
ssid-name:                      corp2   ssid-type:                    crypto
Beacon:                           yes   Proxy ARP:                        no
DHCP restrict:                     no   No broadcast:                     no
Short retry limit:                  5   Long retry limit:                  5
Auth fallthru:                   none   Sygate On-Demand (SODA):         yes
Enforce SODA checks:              yes   SODA remediation ACL:
Custom success web-page:                Custom failure web-page:
Custom logout web-page:                 Custom agent-directory:
Static COS:                        no   COS:                               0
CAC mode:                        none   CAC sessions:                     14
User idle timeout:                180   Idle client probing:             yes
Keep initial vlan:                 no   Web Portal Session Timeout:        5
Web Portal ACL:
WEP Key 1 value:               <none>   WEP Key 2 value:              <none>
WEP Key 3 value:               <none>   WEP Key 4 value:              <none>
WEP Unicast Index:                  1   WEP Multicast Index:               1
Shared Key Auth:                   NO
WPA enabled:
    ciphers: cipher-tkip
    authentication: 802.1X
    TKIP countermeasures time: 60000ms
vlan-name = orange
session-timeout = 300
service-type = 2
11a beacon rate:                  6.0   multicast rate:                 AUTO
11a mandatory rate: 6.0,12.0,24.0 standard rates: 9.0,18.0,36.0,48.0,54.0
11b beacon rate:                  2.0   multicast rate:                 AUTO
11b mandatory rate: 1.0,2.0 standard rates: 5.5,11.0
11g beacon rate:                  2.0   multicast rate:                 AUTO
11g mandatory rate: 1.0,2.0,5.5,11.0 standard rates: 6.0,9.0,12.0,18.0,24.0,
36.0,48.0,54.0
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

25 MANAGING SESSIONS

About the Session Manager

A session is a related set of communication transactions between an authenticated user (client) and the specific station to which the client is bound. Packets are exchanged during a session. A WX switch supports the following kinds of sessions:

- **Administrative sessions** — A network administrator managing the WX
- **Network sessions** — A network user exchanging traffic with a network through the WX

The WX session manager manages the sessions for each client, but does not examine the substance of the traffic.

Clearing (ending) a session deauthenticates the administrator or user from the session and disassociates wireless clients.

Displaying and Clearing Administrative Sessions

To display session information and statistics for a user with administrative access to the WX switch, use the following command:

```
display sessions {admin | console | telnet [client]}
```

You can view all administrative sessions, or only the sessions of administrators with access to the WX through a Telnet or SSH connection or the console port. You can also display information about administrative Telnet sessions from remote clients.

To clear administrative sessions, use the following command:

```
clear sessions {admin | console | telnet
[client [session-id]]}
```

CAUTION: *Clearing administrative sessions might cause your session to be cleared.*

Displaying and Clearing All Administrative Sessions

To view information about the sessions of all administrative users, type the following command:

```
WX1200> display sessions admin


Tty         Username               Time (s)    Type
-------     --------------------   --------    ----
tty0                               3644        Console
tty2        tech                   6           Telnet
tty3        sshadmin               381         SSH

3 admin sessions
```

To clear the sessions of all administrative users, type the following command:

```
WX1200# clear sessions admin
This will terminate manager sessions, do you wish to
continue? (y|n) [n]y
```

Displaying and Clearing an Administrative Console Session

To view information about the user with administrative access to the WX switch through a console plugged into the switch, type the following command:

```
WX1200> display sessions console

Tty         Username               Time (s)    Type
-------     --------------------   --------    ----
tty0                               5310        Console

1 console session
```

To clear the administrative sessions of a console user, type the following command:

```
WX1200# clear sessions console
This will terminate manager sessions, do you wish to
continue? (y|n) [y]y
```

Displaying and Clearing Administrative Telnet Sessions

To view information about administrative Telnet sessions, type the following command:

```
WX1200> display sessions telnet


Tty         Username              Time (s)    Type
-------     --------------------  --------    ----
tty3        sshadmin              2099        SSH

1 telnet session
```

To clear the administrative sessions of Telnet users, type the following command:

```
WX1200# clear sessions telnet
This will terminate manager sessions, do you wish
to continue? (y|n) [y]y
```

Displaying and Clearing Client Telnet Sessions

To view administrative sessions of Telnet clients, type the following command:

```
WX1200# display sessions telnet client


Session   Server Address    Server Port    Client Port
-------   --------------    ------------   -----------
0          192.168.1.81     23             48000
1           10.10.1.22      23             48001
```

To clear the administrative sessions of Telnet clients, use the following command:

```
clear sessions telnet [client [session-id]]
```

You can clear all Telnet client sessions or a particular session. For example, the following command clears Telnet client session 1:

```
WX1200# clear sessions telnet client 1
```

Displaying and Clearing Network Sessions

Use the following command to display information about network sessions:

display sessions network
[**user** *user-glob* | **mac-addr** *mac-addr-glob* | **ssid** *ssid-name*
vlan *vlan-glob* | **session-id** *session-id* | **wired**] [**verbose**]

In most cases, you can display both summary and detailed (verbose) information for a session. For example, the following command displays summary information about all current network sessions:

```
WX1200# display sessions network
User                           Sess  IP or MAC         VLAN            Port/
Name                             ID  Address           Name            Radio
------------------------------ ----  ----------------- --------------- -----
EXAMPLE\wong                     5*  192.168.12.100    vlan-eng         3/1
jose@example.com              5125*  192.168.12.141    vlan-eng         1/1
00:30:65:16:8d:69             4385*  192.168.19.199    vlan-wep         3/1
                               761   00:0b:be:15:46:56 (none)           1/2
                               763   00:02:2d:02:10:f5 (none)           1/1
5 sessions total
```

An asterisk (*) in the *Sess ID* field indicates a session that is currently active. (For more information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

(For information about getting detailed output, see “Displaying Verbose Network Session Information” on page 561.)

You can display and clear network sessions in the following ways:

- By the name of the user. (See “Displaying and Clearing Network Sessions by Username” on page 562.)
- By the MAC address of the user. (See “Displaying and Clearing Network Sessions by MAC Address” on page 563.)
- By the name of the VLAN to which the user belongs. (See “Displaying and Clearing Network Sessions by VLAN Name” on page 563.)
- By the local session ID. (See “Displaying and Clearing Network Sessions by Session ID” on page 564.)

*Authorization attribute values can be changed during authorization. If the values are changed, **display sessions** output shows the values that are actually in effect following any changes.*

Displaying Verbose Network Session Information

In the **display sessions network** commands, you can specify **verbose** to get more in-depth information.

For example, to display detailed information for all network sessions, type the following command:

```
WX1200> display sessions network verbose
User                              Sess  IP or MAC          VLAN            Port/
Name                                ID  Address            Name            Radio
------------------------------ ----  ----------------- --------------- -----
EXAMPLE\wong                         5* 192.168.12.100    vlan-eng         3/1
Client MAC: 00:02:2c:64:8e:1b   GID: SESS-5-000430-835541-bab048c4
State: ACTIVE                  (prev AUTHORIZED)
now on: WX 192.168.12.7, port 10, AP/radio 0422900147/1, as of 02:43:03 ago
jose@example.com               5125* 192.168.12.141    vlan-eng         1/1
Client MAC: 00:01:2e:6e:ab:a5   GID: SESS-5125-000430-843069-2b7d0
State: ACTIVE                  (prev AUTHORIZED)
now on: WX 192.168.12.7, port 1, AP/radio 0422900147/1, as of 00:37:35 ago
00:30:65:16:8d:69              4385* 192.168.19.199    vlan-wep         3/1
Client MAC: 00:10:65:16:8d:69   GID: SESS-4385-000430-842879-bf7a7
State: ACTIVE                  (prev AUTHORIZED)
now on: WX 192.168.12.7, port 3, AP/radio 0222900129/1, as of 00:40:45 ago
                                761  00:0b:be:15:46:56 (none)           1/2
Client MAC: 00:0e:be:15:46:56   GID: SESS-761-000430-845313-671851
State: AUTH AND ASSOC          (prev AUTH,ASSOC REQ)
now on: WX 192.168.12.7, port 1, AP/radio 0422900147/2, as of 00:00:11 ago
User                              Sess  IP or MAC          VLAN            Port/
Name                                ID  Address            Name            Radio
------------------------------ ----  ----------------- --------------- -----
                                763  00:02:2d:02:10:f5 (none)           1/1
Client MAC: 00:02:0d:02:10:f5   GID: SESS-763-000430-845317-fb2c2d
State: AUTH AND ASSOC          (prev AUTH,ASSOC REQ)
now on: WX 192.168.12.7, port 1, AP/radio 0422900147/1, as of 00:00:07 ago
5 sessions total
```

Displaying and Clearing Network Sessions by Username

You can view sessions by a username or user glob. (For a definition of user globs and their format, see "User Globs" on page 30.)

To see all sessions for a specific user or for a group of users, type the following command:

`display sessions network user` *`user-glob`*

For example, the following command shows all sessions of users whose names begin with *E*:

```
WX1200# display sessions network user E*
User                              Sess  IP or MAC          VLAN            Port/
Name                                ID  Address            Name            Radio
------------------------------ ----  ----------------- ---------------
EXAMPLE\singh                    12* 192.168.12.185    vlan-eng        3/2
EXAMPLE\havel                    13* 192.168.12.104    vlan-eng        1/2
2 sessions match criteria (of 3 total)
```

Use the **verbose** keyword to see more information. For example, the following command displays detailed session information about nin@example.com:

```
WX1200> display sessions network user nin@example.com verbose
User                              Sess  IP or MAC          VLAN            Port/
Name                                ID  Address            Name            Radio
------------------------------ ----  ----------------- --------------- -----
nin@example.com                     5* 192.168.12.141    vlan-eng         1/1
Client MAC: 00:02:2d:6e:ab:a5   GID: SESS-5-000430-686792-d8b3c564
State: ACTIVE                   (prev AUTHORIZED)
now on: WX 192.168.12.7, port 1, AP/radio 0422900147/1, as of 00:23:32 ago
1 sessions match criteria (of 10 total)
```

To clear all the network sessions of a user or group of users, use the following command:

`clear sessions network user` *`user-glob`*

For example, the following command clears the sessions of users named Bob:

```
WX1200# clear sessions network user Bob*
```

Displaying and Clearing Network Sessions by MAC Address

You can view sessions by MAC address or MAC address glob. (For a definition of MAC address globs and their format, see “MAC Address Globs” on page 31.) To view session information for a MAC address or set of MAC addresses, type the following command:

```
display sessions network mac-addr mac-addr-glob
```

For example, the following command displays the sessions for MAC address 01:05:5d:7e:98:1a:

```
WX1200> display sessions net mac-addr 01:05:5d:7e:98:1a
User                           Sess  IP or MAC         VLAN            Port/
Name                             ID  Address           Name            Radio
--------------------------- ----  --------------- ------------- -----
EXAMPLE\havel                 13* 192.168.12.104   vlan-eng         1/2
```

To clear all the network sessions for a MAC address or set of MAC addresses, use the following command:

```
clear sessions network mac-addr mac-addr-glob
```

For example, to clear all sessions for MAC address 00:01:02:04:05:06, type the following command:

```
WX1200# clear sessions network mac-addr 00:01:02:04:05:06
```

Displaying and Clearing Network Sessions by VLAN Name

You can view all session information for a specific VLAN or VLAN glob. (For a definition of VLAN globs and their format, see “VLAN Globs” on page 31.)

To see all network sessions information for a VLAN or set of VLANs, type the following command:

```
display sessions network vlan vlan-glob
```

For example, the following command displays the sessions for VLAN *west*:

```
WX1200> display sessions network vlan west
User                           Sess  IP or MAC         VLAN            Port/
Name                             ID  Address           Name            Radio
------------------------------ ----  ----------------- --------------- -----
EXAMPLE\tamara                    8* 192.168.12.174     west             1/1
host/laptop.example.com          11* 192.168.12.164     west             2/1
EXAMPLE\havel                    17* 192.168.12.195     west             1/2
EXAMPLE\jose                     20* 192.168.12.171     west             1/2
EXAMPLE\geetha                   21* 192.168.12.169     west             3/2
```

To clear the sessions on a VLAN or set of VLANs, use the following command:

```
clear sessions network vlan vlan-glob
```

For example, the following command clears the sessions of all users on VLAN *red*:

```
WX1200# clear sessions network vlan red
```

Displaying and Clearing Network Sessions by Session ID

You can display information about a session by session ID. To find local session IDs, enter the **display sessions** command. You can view more detailed information for an individual session, including authorization parameters and, for wireless sessions, packet and radio statistics.

For example, to display information about session 27, type the following command:

```
WX1200> display session network session-id 88
Local Id:    88
Global Id:   SESS-88-00040f-876766-623fd6
State:       ACTIVE
SSID:        Rack-39-PM
Port/Radio:  10/1
MAC Address: 00:0f:66:f4:71:6d
User Name:   last-resort-Rack-39-PM
IP Address:  10.2.39.217
Vlan Name:   default
Tag:         1
Session Start:   Wed Apr 12 21:19:27 2006 GMT
Last Auth Time:  Wed Apr 12 21:19:26 2006 GMT
Last Activity:   Wed Apr 12 21:19:49 2006 GMT  ( <15s ago)
Session Timeout: 0
Idle Time-To-Live: 175
Login Type:      LAST-RESORT
EAP Method:      NONE, using server 172.16.0.1
Session statistics as updated from AP:
Unicast packets in: 31
Unicast bytes in: 3418
Unicast packets out: 18
Unicast bytes out: 2627
Multicast packets in: 0
Multicast bytes in: 0
Number of packets with encryption errors: 0
Number of bytes with encryption errors: 0
Last packet data rate: 48
Last packet signal strength: -60 dBm
Last packet data S/N ratio: 35
Protocol: 802.11
Session CAC: disabled
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

The **verbose** option is not available with the **display sessions network session-id** command.

To clear network sessions by session ID, type the following command with the appropriate local session ID number.

```
clear sessions network session-id session-id
```

For example, the following command deletes network session 9:

```
WX1200# clear sessions network session-id 9
SM Apr 11 19:53:38 DEBUG SM-STATE: localid 9, mac
00:06:25:09:39:5d,
flags 0000012fh, to change state to KILLING
Localid 9, globalid SESSION-9-893249336 moved from ACTIVE to
KILLING
(client=00:06:25:09:39:5d)
```

Displaying and Changing Network Session Timers

MSS periodically sends keepalive probes to wireless clients to verify that the clients are still present. The keepalive probes are null data frames sent as unicasts to each client. MSS expects each client to respond with an Ack. MSS sends the keepalives every 10 seconds. You can disable the keepalives but the keepalive interval is not configurable.

MSS also maintains an idle timer for each user (wireless client). Each time the client sends data or responds to a keepalive probe, MSS resets the idle timer to 0 for the client. However, if the client remains idle for the period of the idle timer, MSS changes the client's session to the Disassociated state. The default idle timeout value is 180 seconds (3 minutes). You can change the timeout to a value from 20 to 86400 seconds. To disable the timeout, specify 0.

Keepalive probes and the user idle timeout are configurable on a service-profile basis.

MSS temporarily keeps session information for disassociated web-portal clients to allow them time to reassociate after roaming. (See "Configuring the Web Portal WebAAA Session Timeout Period" on page 477.)

Disabling Keepalive Probes

To disable or reenable keepalive probes in a service profile, use the following command:

```
set service-profile name idle-client-probing {enable |
disable}
```

Changing or Disabling the User Idle Timeout

To change the user idle timeout for a service profile, use the following command:

```
set service-profile name user-idle-timeout seconds
```

For example, to change the user idle timeout for service profile *sp1* to 6 minutes (360 seconds), use the following command:

```
WX1200# set service-profile sp1 user-idle-timeout 360
success: change accepted.
```

To disable the user idle timeout, use the following command:

```
WX1200# set service-profile sp1 user-idle-timeout 0
success: change accepted.
```

26 ROGUE DETECTION AND COUNTERMEASURES

MAP radios automatically scan the RF spectrum for other devices transmitting in the same spectrum. The RF scans discover third-party transmitters in addition to other 3Com radios. MSS considers the unknown transmitters to be *devices of interest*, which are potential rogues.

Overview

You can display information about the devices of interest. To identify friendly devices, such as unknown access points in your network or neighbor's network, you can add them to the known devices list. You also can enable countermeasures to prevent clients from using the devices that truly are rogues.

With 3Com Wireless Switch Manager, you also can display the physical location of a rogue device. (For more information, see the *Wireless Switch Manager Reference Manual*.)

About Rogues and RF Detection

RF detection detects all the IEEE 802.11 devices in a Mobility Domain and can single out the unauthorized rogue access points.

Rogue Access Points and Clients

A rogue access point is an access point that is not authorized to operate in a network. Rogue access points and their clients undermine the security of an enterprise network by potentially allowing unchallenged access to the network by any wireless user or client in the physical vicinity. Rogue access points and users can also interfere with the operation of your enterprise network.

Rogue Classification

When MSS detects a third-party wireless device that is not allowed on the network, MSS classifies the device as one of the following:

- Rogue—The device is in the 3Com network but does not belong there.
- Interfering device—The device is not part of the 3Com network but also is not a rogue. No client connected to the device has been detected communicating with any network entity listed in the forwarding database (FDB) of any WX switch in the Mobility Domain. Although the interfering device is not connected to your network, the device might be causing RF interference with MAP radios.

When you enable countermeasures, you can specify whether to issue them against rogues and interfering devices, or against rogues only. For example, if you do not want to issue countermeasures against your neighbor’s wireless devices, you can select to issue countermeasures against rogues only. RF Auto-Tuning can automatically change MAP radio channels to work around interfering devices without attacking those devices.

In addition, you can optionally configure MSS to issue *on-demand* countermeasures. On-demand countermeasures are those launched against devices that you have manually specified in the WX switch’s attack list. When you enable on-demand countermeasures, MSS issues them only against the devices that have been manually specified in the attack list, not to other devices determined to be rogues for other reasons, such as policy violations.

When MSS directs a MAP radio to issue countermeasures against a rogue, MSS changes the channel on the radio to the channel on which the rogue traffic is detected. The radio remains on that channel as long as the radio is issuing countermeasures against the rogue, even if RF Auto-Tuning is enabled.

Rogue Detection Lists

Rogue detection lists specify the third-party devices and SSIDs that MSS allows on the network, and the devices MSS classifies as rogues. You can configure the following rogue detection lists:

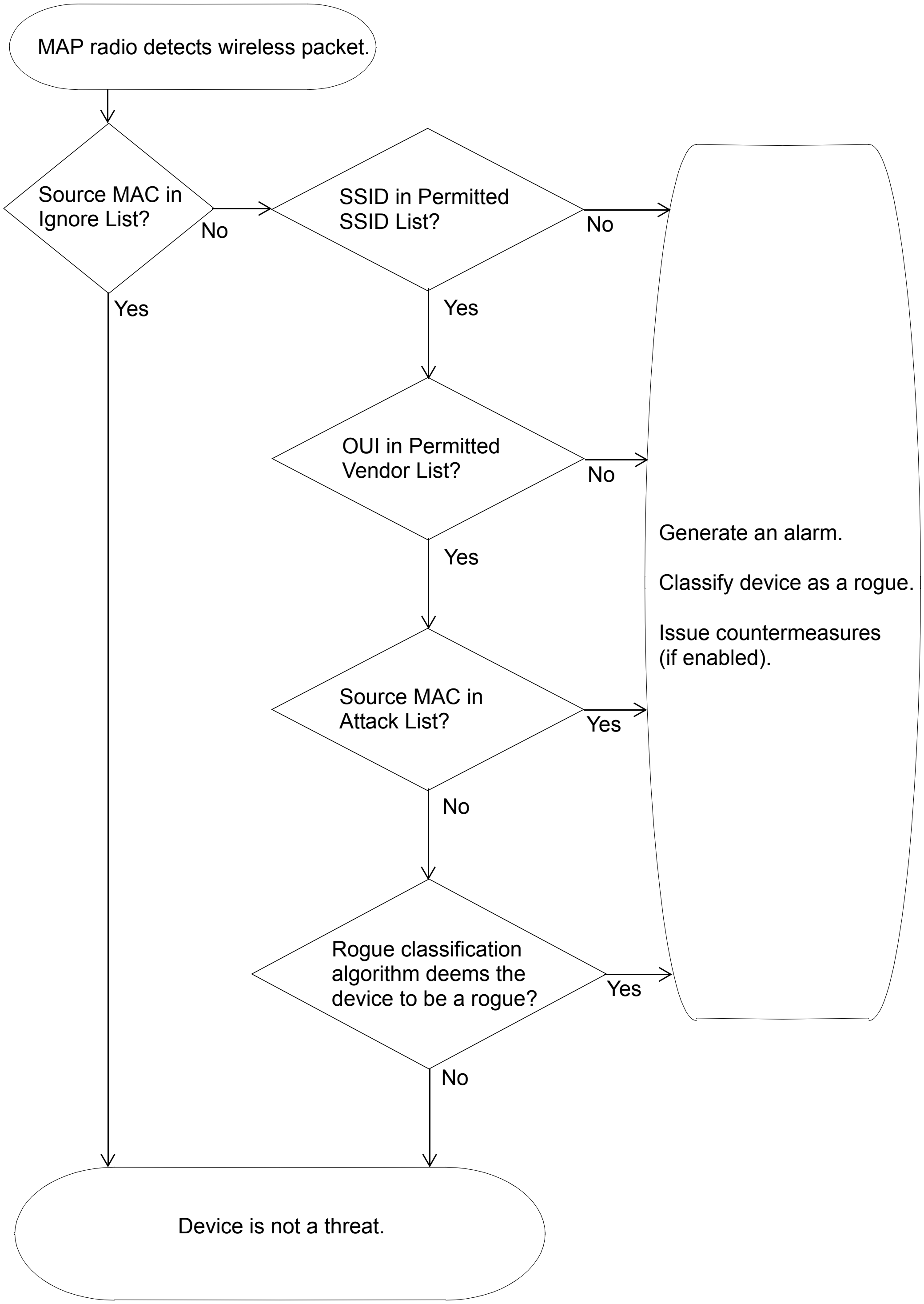
- Permitted SSID list—A list of SSIDs allowed in the Mobility Domain. MSS generates a message if an SSID that is not on the list is detected.
- Permitted vendor list—A list of the wireless networking equipment vendors whose equipment is allowed on the network. The vendor of a piece of equipment is identified by the Organizationally Unique Identifier (OUI), which is the first three bytes of the equipment's MAC address. MSS generates a message if an AP or wireless client with an OUI that is not on the list is detected.
- Client black list—A list of MAC addresses of wireless clients who are not allowed on the network. MSS prevents clients on the list from accessing the network through a WX switch. If the client is placed on the black list dynamically by MSS due to an association, reassociation or disassociation flood, MSS generates a log message.
- Ignore list—A list of third-party devices that you want to exempt from rogue detection. MSS does not count devices on the ignore list as rogues or interfering devices, and does not issue countermeasures against them.

An empty permitted SSID list or permitted vendor list implicitly allows all SSIDs or vendors. However, when you add an entry to the SSID or vendor list, all SSIDs or vendors that are not in the list are implicitly disallowed. An empty client black list implicitly allows all clients, and an empty ignore list implicitly considers all third-party wireless devices to be potential rogues.

All the lists except the black list require manual configuration. You can configure entries in the black list and MSS also can place a client in the black list due to an association, reassociation or disassociation flood from the client.

The rogue classification algorithm examines each of these lists when determining whether a device is a rogue. Figure 34 shows how the rogue detection algorithm uses the lists.

Figure 34 Rogue Detection Algorithm


MAP radio detects wireless packet.
Source MAC in Ignore List?
No
Yes
SSID in Permitted SSID List?
No
Yes
OUI in Permitted Vendor List?
No
Yes
Source MAC in Attack List?
Yes
No
Rogue classification algorithm deems the device to be a rogue?
Yes
No
Generate an alarm.
Classify device as a rogue.
Issue countermeasures (if enabled).
Device is not a threat.

RF Detection Scans

All radios continually scan for other RF transmitters. Radios perform passive scans and active scans:

- **Passive scans** — The radio listens for beacons and probe responses.
- **Active scans** — The radio sends *probe any* requests (probe requests with a null SSID name) to solicit probe responses from other access points.

Passive scans are always enabled and cannot be disabled. Active scans are enabled by default but can be disabled on a radio-profile basis.

Radios perform both types of scans on all channels allowed for the country of operation. (This is the regulatory domain set by the **set system countrycode** command.) 802.11b/g radios scan in the 2.4 GHz to 2.4835 GHz spectrum. 802.11a radios scan in the 5.15 GHz to 5.85 GHz spectrum.

Both enabled radios and disabled radios perform these scans.

The active-scan algorithm is sensitive to high-priority (voice or video) traffic or heavy data traffic. Active-scan scans for 30 msec once every second, unless either of the following conditions is true:

- High-priority traffic (voice or video) is present at 64 Kbps or higher. In this case, active-scan scans for 30 msec every 60 seconds.
- Heavy data traffic is present at 4 Mbps or higher. In this case, active-scan scans for 30 msec every 5 seconds.

On a disabled radio, the radio is dedicated to rogue detection and scans on each channel in round-robin fashion.

Dynamic Frequency Selection (DFS)

Some regulatory domains require conformance to ETSI document EN 301 893. Section 4.6 of that document specifies requirements for Dynamic Frequency Selection (DFS). These requirements apply to radios operating in the 5 GHz band (802.11a radios).

In countries where Dynamic Frequency Selection (DFS) is required, MSS performs the appropriate check for radar. If radar is detected on a channel, the MAP radio stops performing active scans on that channel in accordance with DFS. However, the radio continues to passively scan for beacons from rogue devices.

When a MAP radio detects radar on a channel, the radio switches to another channel and does not attempt to use the channel where the radar was detected for 30 minutes. MSS also generates a message.

The RF Auto-tuning feature must be enabled. Otherwise MSS cannot change the channel.

Countermeasures

You can enable MSS to use countermeasures against rogues. Countermeasures consist of packets that interfere with a client's ability to use the rogue.

Countermeasures are disabled by default. You can enable them on an individual radio-profile basis. When you enable them, all devices of interest that are not in the known devices list become viable targets for countermeasures. Countermeasures can be enabled against all rogue and interfering devices, against rogue devices only, or against devices explicitly configured in the WX switch's attack list. The Mobility Domain's seed switch automatically selects individual radios to send the countermeasure packets.

Mobility Domain Requirement

RF Detection requires the Mobility Domain to be completely up. If a Mobility Domain is not fully operational (not all members are up), no new RF Detection data is processed. Existing RF Detection information ages out normally. Processing of RF Detection data is resumed only when all members of the Mobility Domain are up. If a seed switch in the Mobility Domain cannot resume full operation, you can restore the Mobility Domain to full operation, and therefore resume RF Detection data processing, by removing the inoperative switch from the member list on the seed.

Summary of Rogue Detection Features

Table 48 lists the rogue detection features in MSS.

Table 48 Rogue Detection Features

Rogue Detection Feature	Description	Applies To	
		Third-Party APs	**Clients**
Classification	MSS can classify third-party APs as rogues or interfering devices. A rogue is a third-party AP whose MAC address MSS knows from the wired side of the network. An interfering device does not have a MAC address known on the wired side. MSS can detect rogue clients, locate their APs, and issue countermeasures against the APs.	Yes	Yes
Permitted vendor list	List of OUIs to allow on the network. An OUI is the first three octets of a MAC address and uniquely identifies an AP's or client's vendor.	Yes	No
Permitted SSID list	List of SSIDs allowed on the network. MSS can issue countermeasures against third-party APs sending traffic for an SSID that is not on the list.	Yes	Yes
Client black list	List of client or AP MAC addresses that are not allowed on the wireless network. MSS drops all packets from these clients or APs.	Yes	Yes
Attack list	List of AP MAC addresses to attack. MSS can issue countermeasures against these APs whenever they are detected on the network.	Yes	No
Ignore list	List of MAC addresses to ignore during RF detection. MSS does not classify devices on this list as rogues or interfering devices, and does not issue countermeasures against them.	Yes	Yes

Table 48 Rogue Detection Features (continued)

Rogue Detection Feature	Description	Applies To	
		Third-Party APs	**Clients**
Countermeasures	Packets sent by 3Com MAPs to interfere with the operation of a rogue or interfering device. Countermeasures are configurable on a radio-profile basis.	Yes	Yes
Active scan	Active scan sends probe any requests (probes with a null SSID name) to look for rogue APs. Active scan is configurable on a radio-profile basis.	Yes	No
3Com MSP signature	Value in a MAP's management frames that identifies the MAP to MSS. MAP signatures help prevent spoofing of the MAP MAC address.	No	No
Log messages and traps	Messages and traps for rogue activity. Messages are described in "IDS and DoS Alerts" on page 584.	Yes	Yes

Configuring Rogue Detection Lists

The following sections describe how to configure lists to specify the devices that are allowed on the network and the devices that MSS should attack with countermeasures.

(For information about how MSS uses the lists, see "Rogue Detection Lists" on page 569.)

Configuring a Permitted Vendor List

The permitted vendor list specifies the third-party AP or client vendors that are allowed on the network. MSS does not list a device as a rogue or interfering device if the device's OUI is in the permitted vendor list.

By default, the permitted vendor list is empty and all vendors are allowed. If you configure a permitted vendor list, MSS allows only the devices whose OUIs are on the list. The permitted vendor list applies only to the WX switch on which the list is configured. WX switches do not share permitted vendor lists.

If you add a device that MSS has classified as a rogue to the permitted vendor list, but not to the ignore list, MSS can still classify the device as a rogue. Adding an entry to the permitted vendor list merely indicates that the device is from an allowed vendor. However, to cause MSS to stop classifying the device as a rogue, you must add the device's MAC address to the ignore list.

To add an entry to the permitted vendor list, use the following command:

```
set rfdetect vendor-list {client | ap} mac-addr
```

The following command adds an entry for clients whose MAC addresses start with aa:bb:cc:

```
WX1200# set rfdetect vendor-list client aa:bb:cc:00:00:00
success:  MAC aa:bb:cc:00:00:00 is now in client vendor-list.
```

The trailing 00:00:00 value is required.

To display the permitted vendor list, use the following command:

```
display rfdetect vendor-list
```

The following example shows the permitted vendor list on a switch:

```
WX1200# display rfdetect vendor-list
Total number of entries: 1
       OUI         Type
----------------- ------
aa:bb:cc:00:00:00 client
11:22:33:00:00:00 ap
```

To remove an entry from the permitted vendor list, use the following command:

```
clear rfdetect vendor-list {client | ap} {mac-addr | all}
```

The following command removes client OUI aa:bb:cc:00:00:00 from the permitted vendor list:

```
WX1200# clear rfdetect vendor-list client aa:bb:cc:00:00:00
success: aa:bb:cc:00:00:00 is no longer in client
vendor-list.
```

Configuring a Permitted SSID List

The permitted SSID list specifies the SSIDs that are allowed on the network. If MSS detects packets for an SSID that is not on the list, the AP that sent the packets is classified as a rogue. MSS issues countermeasures against the rogue if they are enabled.

By default, the permitted SSID list is empty and all SSIDs are allowed. If you configure a permitted SSID list, MSS allows traffic only for the SSIDs that are on the list. The permitted SSID list applies only to the WX switch on which the list is configured. WX switches do not share permitted SSID lists.

If you add a device that MSS has classified as a rogue to the permitted SSID list, but not to the ignore list, MSS can still classify the device as a rogue. Adding an entry to the permitted SSID list merely indicates that the device is using an allowed SSID. However, to cause MSS to stop classifying the device as a rogue, you must add the device's MAC address to the ignore list.

To add an SSID to the list, use the following command:

```
set rfdetect ssid-list ssid-name
```

The following command adds SSID *mycorp* to the list of permitted SSIDs:

```
WX4400# set rfdetect ssid-list mycorp
success:  ssid mycorp is now in ssid-list.
```

To display the permitted SSID list, use the following command:

```
display rfdetect ssid-list
```

The following example shows the permitted SSID list on a WX switch:

```
WX1200# display rfdetect ssid-list
Total number of entries: 3
       SSID
-----------------
           mycorp
        corporate
            guest
```

To remove an SSID from the permitted SSID list, use the following command:

```
clear rfdetect ssid-list ssid-name
```

The following command clears SSID *mycorp* from the permitted SSID list:

```
WX1200# clear rfdetect ssid-list mycorp
success: mycorp is no longer in ssid-list.
```

Configuring a Client Black List

The client black list specifies clients that are not allowed on the network. MSS drops all packets from the clients on the black list.

By default, the client black list is empty. In addition to manually configured entries, the list can contain entries added by MSS. MSS can place a client in the black list due to an association, reassociation or disassociation flood from the client.

The client black list applies only to the WX switch on which the list is configured. WX switches do not share client black lists.

To add an entry to the list, use the following command:

```
set rfdetect black-list mac-addr
```

The following command adds client MAC address 11:22:33:44:55:66 to the black list:

```
WX1200# set rfdetect black-list 11:22:33:44:55:66
success:  MAC 11:22:33:44:55:66 is now blacklisted.
```

To display the client black list, use the following command:

```
display rfdetect black-list
```

The following example shows the client black list on WX switch:

```
WX1200# display rfdetect black-list
Total number of entries: 1
  Blacklist MAC         Type          Port   TTL
----------------- ----------------- ------- ---
11:22:33:44:55:66 configured        -         -
11:23:34:45:56:67 assoc req flood   3        25
```

To remove a MAC address from the client black list, use the following command:

```
clear rfdetect black-list mac-addr
```

The following command removes MAC address 11:22:33:44:55:66 from the black list:

```
WX1200# clear rfdetect black-list 11:22:33:44:55:66
success: 11:22:33:44:55:66 is no longer blacklisted.
```

Configuring an Attack List

The attack list specifies the MAC addresses of devices that MSS should issue countermeasures against whenever the devices are detected on the network. The attack list can contain the MAC addresses of APs and clients.

By default, the attack list is empty. The attack list applies only to the WX switch on which the list is configured. WX switches do not share attack lists.

When on-demand countermeasures are enabled, only those devices configured in the attack list are subject to countermeasures. In this case, devices found to be rogues by other means, such as policy violations or by determining that the device is providing connectivity to the wired network, are not attacked.

If you are using on-demand countermeasures in a Mobility Domain, you should synchronize the attack lists on all the WX switches in the Mobility Domain. See "Using On-Demand Countermeasures in a Mobility Domain" on page 581.

To add an entry to the attack list, use the following command:

```
set rfdetect attack-list mac-addr
```

The following command adds MAC address aa:bb:cc:44:55:66 to the attack list:

```
WX4400# set rfdetect attack-list 11:22:33:44:55:66
success:  MAC 11:22:33:44:55:66 is now in attacklist.
```

To display the attack list, use the following command:

```
display rfdetect attack-list
```

The following example shows the attack list on a switch:

```
WX4400# display rfdetect attack-list
Total number of entries: 1
 Attacklist MAC    Port/Radio/Chan   RSSI      SSID
----------------- ----------------- ------ ------------
11:22:33:44:55:66  dap 2/1/11       -53    rogue-ssid
```

To remove a MAC address from the attack list, use the following command:

```
clear rfdetect attack-list mac-addr
```

The following command clears MAC address 11:22:33:44:55:66 from the attack list:

```
WX4400# clear rfdetect attack-list 11:22:33:44:55:66
success: 11:22:33:44:55:66 is no longer in attacklist.
```

Configuring an Ignore List

By default, when countermeasures are enabled, MSS considers any non-3Com transmitter to be a rogue device and can send countermeasures to prevent clients from using that device. To prevent MSS from sending countermeasures against a friendly device, add the device to the known devices list:

If you add a device that MSS has classified as a rogue to the permitted vendor list or permitted SSID list, but not to the ignore list, MSS can still classify the device as a rogue. Adding an entry to the permitted vendor list or permitted SSID list merely indicates that the device is from an allowed manufacturer or is using an allowed SSID. However, to cause MSS to stop classifying the device as a rogue, you must add the device's MAC address to the ignore list.

To add a device to the ignore list, use the following command:

```
set rfdetect ignore mac-addr
```

The *mac-addr* is the BSSID of the device you want to ignore.

If you try to initiate countermeasures against a device on the ignore list, the ignore list takes precedence and MSS does not issue the countermeasures. Countermeasures apply only to rogue devices.

To ignore BSSID *aa:bb:cc:11:22:33* during all RF scans, type the following command:

```
WX1200#set rfdetect ignore aa:bb:cc:11:22:33
success:  MAC aa:bb:cc:11:22:33 is now ignored.
```

To remove a BSSID from the ignore list, use the following command:

```
clear rfdetect ignore mac-addr
```

To display the ignore list, use the following command:

```
display rfdetect ignore
```

The following command displays an ignore list containing two BSSIDs:

```
WX4400# display rfdetect ignore
Total number of entries: 2
   Ignore MAC
-----------------
aa:bb:cc:11:22:33
aa:bb:cc:44:55:66
```

Enabling Countermeasures

Countermeasures are disabled by default. You can enable them on an individual radio profile basis. To enable countermeasures on a radio profile, use the following command:

```
set radio-profile name countermeasures {all | rogue |
configured | none}
```

The **all** option enables or disables countermeasures for rogues and for interfering devices. This option is equivalent to the scope of rogue detection in MSS Version 3.x. The **rogue** option enables or disables countermeasures for rogues only.

The **configured** option causes radios to attack only devices specified in the attack list on the WX switch (*on-demand* countermeasures). When this option is used, devices found to be rogues by other means, such as policy violations or by determining that the device is providing connectivity to the wired network, are not attacked.

The **none** option disables countermeasures for this radio profile.

The following command enables countermeasures in radio profile *radprof3* for rogues only:

```
WX4400# set radio-profile radprof3 countermeasures rogue
success: change accepted.
```

The following command causes radios managed by radio profile *radprof3* to issue countermeasures against devices in the WX switch's attack list:

```
WX4400# set radio-profile radprof3 countermeasures configured
success: change accepted.
```

To disable countermeasures on a radio profile, use the following command:

```
clear radio-profile name countermeasures
```

The following command disables countermeasures in radio profile *radprof3*:

```
WX4400# clear radio-profile radprof3 countermeasures
success: change accepted.
```

Using On-Demand Countermeasures in a Mobility Domain

If you are using on-demand countermeasures in a Mobility Domain, you should enable the feature and synchronize the attack lists on all the WX switches in the Mobility Domain. This ensures a WX switch attacks devices in its attack list, rather than devices that may be specified in the attack lists of other WX switches in the Mobility Domain, which could produce unexpected results.

For example, in a Mobility Domain consisting of three WX switches, if WX switch A has an attack list consisting of MAC address 1, and WX switch B has an attack list consisting of MAC address 2, then WX switch C (the seed for the Mobility Domain) might determine that the optimal radio to attack MAC address 2 is attached to WX switch A.

This would mean that MAC address 2 would be attacked from WX switch A, even though MAC address 2 does not reside in WX switch A's attack list. In addition, if the MAP attached to WX switch A is busy attacking MAC address 2, then MAC address 1 might not be attacked at all if it comes on the network.

By making the attack lists identical on all of the WX switches in the Mobility Domain when you enable on-demand countermeasures, it ensures that a WX switch always attacks MAC addresses that reside in its attack list. Note that WX switches do not share attack lists automatically, so you must manually synchronize the attack lists on the WX switches in the Mobility Domain.

Disabling or Reenabling Active Scan

When active scanning is enabled, the MAP radios managed by the switch look for rogue devices by sending *probe any* frames (probes with a null SSID name), to solicit probe responses from other APs.

Active scan is enabled by default. You can disable or reenable the feature on an individual radio profile basis. To disable or reenable active scan on a radio profile, use the following command:

```
set radio-profile name active-scan {enable | disable}
```

The following command disables active scan in radio profile *radprof3*:

```
WX1200# set radio-profile radprof3 active-scan disable
success: change accepted.
```

Enabling MAP Signatures

A MAP signature is a set of bits in a management frame sent by a MAP that identifies that MAP to MSS. If someone attempts to spoof management packets from a 3Com MAP, MSS can detect the spoof attempt.

MAP signatures are disabled by default. To enable or disable them, use the following command:

```
set rfdetect signature {enable | disable}
```

The command applies only to MAPs managed by the WX switch on which you enter the command. To enable signatures on all MAPs in a Mobility Domain, enter the command on each WX switch in the Mobility Domain.

You must use the same MAP signature setting (enabled or disabled) on all WX switches in a Mobility Domain.

Creating an Encrypted RF Fingerprint Key as a MAP Signature

To create an encrypted RF fingerprint key to use as a signature for a MAP, use the following command:

```
set rfdetect signature key encrypted <key_value>
```

For example:

```
WXR100_desk# set rfdetect ?
attack-list   Add a device to attack-list
black-list    black-list specific device
ignore        set rfdetect transmitter mac to be ignored
log           set rfdetect log messages enable/disable
signature     set rfdetect signature operations
ssid-list     add an ssid to allowed ssid list
vendor-list   add a device to vendor-list

WXR100_desk# set rfdetect signature ?
<enable>      enable or disable AP mgmt-frame signatures
key           set rfdetect signature key operations

WXR100_desk# set rfdetect signature key ?
<key_value>   RF key fingerprint (16 bytes separated by
colons) on the AP
encrypted     set the signature key used in management frames

WXR100_desk# set rfdetect signature key encrypted ?
<key_value>   RF encrypted key fingerprint

WXR100_desk# set rfdetect signature key encrypted
```

Disabling or Reenabling Logging of Rogues

By default, a WX switch generates a log message when a rogue is detected or disappears. To disable or reenable the log messages, use the following command:

```
set rfdetect log {enable | disable}
```

To display log messages on a switch, use the following command:

```
display log buffer
```

(This command has optional parameters. For complete syntax information, see the *Wireless LAN Switch and Controller Command Reference*.)

Enabling Rogue and Countermeasures Notifications

By default, all SNMP notifications (informs or traps) are disabled. To enable or disable notifications for rogue detection, Intrusion Detection System (IDS), and Denial of Service (DoS) protection, configure a notification profile that sends all the notification types for these features. (For syntax information and an example, see "Configuring a Notification Profile" on page 144.)

IDS and DoS Alerts

MSS can detect illegitimate network access attempts and attempts to disrupt network service. In response, MSS generates messages and SNMP notifications. The following sections describe the types of attacks and security risks that MSS can detect.

For examples of the log messages that MSS generates when DoS attacks or other security risks are detected, see "IDS Log Message Examples" on page 587.

For information about the notifications, see "Configuring a Notification Profile" on page 144.

To detect DoS attacks, active scan must be enabled. (See "Disabling or Reenabling Active Scan" on page 582.)

Flood Attacks

A flood attack is a type of Denial of Service attack. During a flood attack, a rogue wireless device attempts to overwhelm the resources of other wireless devices by continuously injecting management frames into the air. For example, a rogue client can repeatedly send association requests to try to overwhelm APs that receive the requests.

The threshold for triggering a flood message is 100 frames of the same type from the same MAC address, within a one-second period. If MSS detects more than 100 of the same type of wireless frame within one second, MSS generates a log message. The message indicates the frame type, the MAC address of the sender, the listener (MAP and radio), channel number, and RSSI.

DoS Attacks

When active scan is enabled on MAPs, MSS can detect the following types of DoS attacks:

- RF Jamming—The goal of an RF jamming attack is to take down an entire WLAN by overwhelming the radio environment with high-power noise. A symptom of an RF jamming attack is excessive interference. If a MAP radio detects excessive interference on a channel, and RF Auto-Tuning is enabled, MSS changes the radio to a different channel.
- Deauthenticate frames—Spoofed deauthenticate frames form the basis for most DoS attacks, and are the basis for other types of attacks including man-in-the-middle attacks. The source MAC address is spoofed so that clients think the packet is coming from a legitimate AP. If a MAP detects a packet with its own source MAC address, the MAP knows that the packet was spoofed.
- Broadcast deauthenticate frames—Similar to the spoofed deauthenticate frame attack above, a broadcast deauthenticate frame attack generates spoofed deauthenticate frames, with a broadcast destination address instead of the address of a specific client. The intent of the attack is to disconnect all stations attached to an AP.
- Disassociation frames—A disassociation frame from an AP instructs the client to end its association with the AP. The intent of this attack is to disconnect clients from the AP.
- Null probe responses—A client’s probe request frame is answered by a probe response containing a null SSID. Some NIC cards lock up upon receiving such a probe response.

- Decrypt errors—An excessive number of decrypt errors can indicate that multiple clients are using the same MAC address. A device's MAC address is supposed to be unique. Multiple instances of the same address can indicate that a rogue device is pretending to be a legitimate device by spoofing its MAC address.
- Fake AP—A rogue device sends beacon frames for randomly generated SSIDs or BSSIDs. This type of attack can cause clients to become confused by the presence of so many SSIDs and BSSIDs, and thus interferes with the clients' ability to connect to valid APs. This type of attack can also interfere with RF Auto-Tuning when a MAP is trying to adjust to its RF neighborhood.
- SSID masquerade—A rogue device pretends to be a legitimate AP by sending beacon frames for a valid SSID serviced by APs in your network. Data from clients that associate with the rogue device can be accessed by the hacker controlling the rogue device.
- Spoofed AP—A rogue device pretends to be a 3Com MAP by sending packets with the source MAC address of the 3Com MAP. Data from clients that associate with the rogue device can be accessed by the hacker controlling the rogue device.

MSS detects a spoofed AP attack based on the fingerprint of the spoofed MAP. Packets from the real MAP have the correct signature, while spoofed packets lack the signature. (See "Enabling MAP Signatures" on page 582.)

Netstumbler and Wellenreiter Applications

Netstumbler and Wellenreiter are widely available applications that hackers can use to gather information about the APs in your network, including location, manufacturer, and encryption settings.

Wireless Bridge

A wireless bridge can extend a wireless network outside the desired area. For example, someone can place a wireless bridge near an exterior wall to extend wireless coverage out into the parking lot, where a hacker could then gain access to the network.

Ad-Hoc Network

An ad-hoc network is established directly among wireless clients and does not use the infrastructure network (a network using an AP). An ad-hoc network might not be an intentionally malicious attack on the network, but it does steal bandwidth from your infrastructure users.

Weak WEP Key Used by Client

A weak initialization vector (IV) makes a WEP key easier to hack. MSS alerts you regarding clients who are using weak WEP IVs so that you can strengthen the encryption on these clients or replace the clients.

Disallowed Devices or SSIDs

You can configure the following types of lists to explicitly allow specific devices or SSIDs:

- Permitted SSID list—MSS generates a message if an SSID that is not on the list is detected.
- Permitted vendor list—MSS generates a message if an AP or wireless client with an OUI that is not on the list is detected.
- Client black list—MSS prevents clients on the list from accessing the network through a WX switch. If the client is placed on the black list dynamically by MSS due to an association, reassociation or disassociation flood, MSS generates a log message.

By default, these lists are empty and all SSIDs, vendors, and clients are allowed. For more information, see "Summary of Rogue Detection Features" on page 573.

Displaying Statistics Counters

To display IDS and DoS statistics counters, use the **display rfdetect counters** commands. (See "Displaying Statistics Counters" on page 587.)

IDS Log Message Examples

Table 49 shows examples of the log messages generated by IDS.

Table 49 IDS and DoS Log Messages

Message Type	Example Log Message
Probe message flood	Client aa:bb:cc:dd:ee:ff is sending probe message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Authentication message flood	Client aa:bb:cc:dd:ee:ff is sending authentication message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Null data message flood	Client aa:bb:cc:dd:ee:ff is sending null data message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.

Table 49 IDS and DoS Log Messages (continued)

Message Type	Example Log Message
Management frame 6 flood	Client aa:bb:cc:dd:ee:ff is sending rsvd mgmt frame 6 message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Management frame 7 flood	Client aa:bb:cc:dd:ee:ff is sending rsvd mgmt frame 7 message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Management frame D flood	Client aa:bb:cc:dd:ee:ff is sending rsvd mgmt frame D message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Management frame E flood	Client aa:bb:cc:dd:ee:ff is sending rsvd mgmt frame E message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Management frame F flood	Client aa:bb:cc:dd:ee:ff is sending rsvd mgmt frame F message flood. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Associate request flood	Client aa:bb:cc:dd:ee:ff is sending associate request flood on port 2
Reassociate request flood	Client aa:bb:cc:dd:ee:ff is sending re-associate request flood on port 2
Disassociate request flood	Client aa:bb:cc:dd:ee:ff is sending disassociate request flood on port 2
Weak WEP initialization vector (IV)	Client aa:bb:cc:dd:ee:ff is using weak wep initialization vector. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Decrypt errors	Client aa:bb:cc:dd:ee:ff is sending packets with decrypt errors. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Spoofed deauthentication frames	Deauthentication frame from AP aa:bb:cc:dd:ee:ff is being spoofed. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.

Table 49 IDS and DoS Log Messages (continued)

Message Type	Example Log Message
Spoofed disassociation frames	Disassociation frame from AP aa:bb:cc:dd:ee:ff is being spoofed. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Null probe responses	AP aa:bb:cc:dd:ee:ff is sending null probe responses. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Broadcast deauthentications	AP aa:bb:cc:dd:ee:ff is sending broadcast deauthentications. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53.
Fake AP SSID (when source MAC address is known)	FakeAP SSID attack detected from aa:bb:cc:dd:ee:ff. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53 SSID myssid.
Fake AP SSID (when source MAC address is not known)	FakeAP BSSID attack detected. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53 SSID myssid.
Spoofed SSID	AP Mac aa:bb:cc:dd:ee:ff(ssid myssid) is masquerading our ssid used by aa:bb:cc:dd:ee:fd. Detected by listener aa:bb:cc:dd:ee:fc(port 2, radio 1), channel 11 with RSSI -53.
Wireless bridge detected	Wireless bridge detected with address aa:bb:cc:dd:ee:ff. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53 SSID myssid.
Netstumbler detected	Netstumbler detected from aa:bb:cc:dd:ee:ff. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53 SSID myssid.
Wellenreiter detected	Wellenreiter detected from aa:bb:cc:dd:ee:ff. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53 SSID myssid.
Ad-hoc client frame detected	Adhoc client frame detected from aa:bb:cc:dd:ee:ff. Seen by AP on port 2, radio 1 on channel 11 with RSSI -53 SSID myssid.

Table 49 IDS and DoS Log Messages (continued)

Message Type	Example Log Message
Spoofed AP	AP Mac aa:bb:cc:dd:ee:ff(ssid myssid) is being spoofed. Received fingerprint 1122343 does not match our fingerprint 123344. Detected by listener aa:bb:cc:dd:ee:fd(port 2, radio 1), channel 11 with RSSI -53.
Disallowed SSID detected	AP Mac aa:bb:cc:dd:ee:ff(ssid myssid) is not part of ssid-list. Detected by listener aa:bb:cc:dd:ee:fd(port 2, radio 1), channel 11 with RSSI -53.
AP from disallowed vendor detected	AP Mac aa:bb:cc:dd:ee:ff(ssid myssid) is not part of vendor-list. Detected by listener aa:bb:cc:dd:ee:fd(port 2, radio 1), channel 11 with RSSI -53.
Client from disallowed vendor detected	Client Mac aa:bb:cc:dd:ee:ff is not part of vendor-list. Detected by listener aa:bb:cc:dd:ee:fd(port 2, radio 1), channel 11 with RSSI -53.
Interfering client seen on wired network	Client Mac aa:bb:cc:dd:ee:ff is seen on the wired network by WX 10.1.1.1 on port 3 vlan 2 tag 1. Detected by listener aa:bb:cc:dd:ee:fd(port 2, radio 1), channel 11 with RSSI -53.

Displaying RF Detection Information

You can use the CLI commands listed in Table 50 to display rogue detection information.

Table 50 Rogue Detection Display Commands

Command	Description
display rfdetect clients [**mac** *mac-addr*]	Displays all wireless clients detected on the air.
display rfdetect counters	Displays statistics for rogue and Intrusion Detection System (IDS) activity detected by the MAPs managed by a WX switch.
display rfdetect mobility-domain [**ssid** *ssid-name* | **bssid** *mac-addr*]	Displays information about rogues detected in a Mobility Domain. This command is valid only on the Mobility Domain's seed switch.

Table 50 Rogue Detection Display Commands (continued)

Command	Description
display rfdetect data	Displays information about all BSSIDs detected on the air, and labels those that are from rogues or interfering devices. This command is valid on any switch in the Mobility Domain.
display rfdetect visible *mac-addr* **display rfdetect visible ap** *map-num* [**radio** {**1** | **2**}]	Displays the BSSIDs detected by a specific 3Com radio.
display rfdetect countermeasures	Displays the current status of countermeasures against rogues in the Mobility Domain. This command is valid only on the Mobility Domain seed.
display rfdetect vendor-list	Displays the list of OUIs that are allowed on the network. An OUI identifies a piece of networking equipment's vendor. (See "Configuring a Permitted Vendor List" on page 574.)
display rfdetect ssid-list	Displays the list of SSIDs that are allowed on the network. (See "Configuring a Permitted SSID List" on page 576.)
display rfdetect black-list	Displays the list of wireless clients that are not allowed on the network. (See "Configuring a Client Black List" on page 577.)
display rfdetect attack-list	Displays the list of wireless devices that you want MAPs to attack with countermeasures. (See "Configuring an Attack List" on page 578.)
display rfdetect ignore	Displays the BSSIDs of third-party devices that MSS ignores during RF detection scans. (See "Configuring an Ignore List" on page 579.)

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Rogue Clients

To display the wireless clients detected by a WX switch, use the following command:

display rfdetect clients [**mac** *mac-addr*]

The following command shows information about all wireless clients detected by a WX switch's MAPs:

```
WX# display rfdetect clients
Total number of entries: 58
Client MAC         Client       AP MAC          AP   AP/Radio   NoL Type  Last
                   Vendor                    Vendor    /Channel           seen
-----------------  ------- ----------------- ------- ---------- --- ----- ----
00:04:23:53:4c:39    Intel           Unknown              7/1/3   1 intfr   56
00:05:4e:4f:fa:1d  Unknown 00:0b:0e:23:1e:c1 3Com     7/2/44   2 intfr  103
00:05:5d:79:ce:03   D-Link           Unknown             7/1/10   2 intfr  151
00:05:5d:79:ce:04   D-Link           Unknown              7/1/9   1 intfr   77
00:05:5d:7e:96:a1   D-Link           Unknown             7/2/52   1 intfr    6
00:05:5d:7e:96:ce   D-Link           Unknown             7/2/48   2 intfr   70
00:05:5d:97:97:82   D-Link           Unknown              7/2/52   1 intfr  812
00:06:25:13:07:5f  Linksys           Unknown              7/1/6   1 intfr   54
00:09:5b:66:ec:1b  Netgear           Unknown             7/2/64   2 intfr   28
00:0b:0e:0c:10:ff  3Com 00:0b:0e:30:83:41 3Com    7/2/161   1 intfr  205
00:0b:0e:17:bb:3f  3Com 00:0b:0e:31:55:41 3Com    7/2/153   1 intfr   15
```

The following command displays more details about a specific client:

```
WX1200# display rfdetect clients mac 00:0c:41:63:fd:6d
Client Mac Address: 00:0c:41:63:fd:6d, Vendor: Linksys
    Port: dap 1, Radio: 1, Channel: 11, RSSI: -82, Rate: 2, Last Seen (secs ago): 84
    Bssid: 00:0b:0e:01:02:00, Vendor: 3Com, Type: intfr, Dst: ff:ff:ff:ff:ff:ff
    Last Rogue Status Check (secs ago): 3
```

The first line lists information for the client. The other lines list information about the most recent 802.11 packet detected from the client.

Displaying Rogue Detection Counters

To display rogue detection statistics counters, use the following command:

`display rfdetect counters`

The command shows counters for rogue activity detected by the WX switch on which you enter the command.

```
WX1200# display rfdetect counters
Type                                               Current      Total
-------------------------------------------------- ------------ ------------

Rogue access points                                           0            0
Interfering access points                                   139         1116
Rogue 802.11 clients                                          0            0
Interfering 802.11 clients                                    4          347
802.11 adhoc clients                                          0            1
Unknown 802.11 clients                                       20          965
Interfering 802.11 clients seen on wired network              0            0
802.11 probe request flood                                    0            0
802.11 authentication flood                                   0            0
802.11 null data flood                                        0            0
802.11 mgmt type 6 flood                                      0            0
802.11 mgmt type 7 flood                                      0            0
802.11 mgmt type d flood                                      0            0
802.11 mgmt type e flood                                      0            0
802.11 mgmt type f flood                                      0            0
802.11 association flood                                      0            0
802.11 reassociation flood                                    0            0
802.11 disassociation flood                                   0            0
Weak wep initialization vectors                               0            0
Spoofed access point mac-address attacks                      0            0
Spoofed client mac-address attacks                            0            0
Ssid masquerade attacks                                       1           12
Spoofed deauthentication attacks                              0            0
Spoofed disassociation attacks                                0            0
Null probe responses                                        626        11380
Broadcast deauthentications                                   0            0
FakeAP ssid attacks                                           0            0
FakeAP bssid attacks                                          0            0
Netstumbler clients                                           0            0
Wellenreiter clients                                          0            0
Active scans                                               1796         4383
Wireless bridge frames                                      196          196
Adhoc client frames                                           8            0
Access points present in attack-list                          0            0
Access points not present in ssid-list                        0            0
Access points not present in vendor-list                      0            0
Clients not present in vendor-list                            0            0
Clients added to automatic black-list                         0            0
```

MSS generates log messages for most of these statistics. See "IDS and DoS Alerts" on page 584.

Displaying SSID or BSSID Information for a Mobility Domain

To display SSID or BSSID information for an entire Mobility Domain, use the following command on the seed switch:

```
display rfdetect mobility-domain [ssid ssid-name | bssid
mac-addr]
```

The following command displays summary information for all SSIDs and BSSIDs detected in the Mobility Domain:

```
WX1200# display rfdetect mobility-domain
Total number of entries: 194
Flags: i = infrastructure, a = ad-hoc, u = unresolved
       c = CCMP, t = TKIP, 1 = 104-bit WEP, 4 = 40-bit WEP, w = WEP(non-WPA)
BSSID             Vendor       Type  Flags  SSID
----------------- ------------ ----- ------ --------------------------------
00:07:50:d5:cc:91        Cisco intfr i----w r27-cisco1200-2
00:07:50:d5:dc:78        Cisco intfr i----w r116-cisco1200-2
00:09:b7:7b:8a:54        Cisco intfr i-----
00:0a:5e:4b:4a:c0         3Com intfr i----- public
00:0a:5e:4b:4a:c2         3Com intfr i----w 3Comwlan
00:0a:5e:4b:4a:c4         3Com intfr ic---- 3Com-ccmp
00:0a:5e:4b:4a:c6         3Com intfr i----w 3Com-tkip
00:0a:5e:4b:4a:c8         3Com intfr i----w 3Com-voip
00:0a:5e:4b:4a:ca         3Com intfr i----- 3Com-webaaa
```

...

The lines in this display are compiled from data from multiple listeners (MAP radios). If an item has the value *unresolved*, not all listeners agree on the value for that item. Generally, an unresolved state occurs only when a MAP or a Mobility Domain is still coming up, and lasts only briefly.

The following command displays detailed information for rogues using SSID *3Com-webaaa*.

```
WX1200# display rfdetect mobility-domain ssid 3Com-webaaa
BSSID: 00:0a:5e:4b:4a:ca Vendor: 3Com SSID: 3Com-webaaa
Type: intfr Adhoc: no Crypto-types: clear
```

```
  WX-IPaddress: 10.8.121.102 Port/Radio/Ch: 3/1/11 Mac: 00:0b:0e:00:0a:6a
  Device-type: interfering Adhoc: no Crypto-types: clear
  RSSI: -85 SSID: 3Com-webaaa

BSSID: 00:0b:0e:00:7a:8a Vendor: 3Com SSID: 3Com-webaaa
Type: intfr Adhoc: no Crypto-types: clear

  WX1200-IPaddress: 10.8.121.102 Port/Radio/Ch: 3/1/1 Mac: 00:0b:0e:00:0a:6a
  Device-type: interfering Adhoc: no Crypto-types: clear
  RSSI: -75 SSID: 3Com-webaaa

  WX1200-IPaddress: 10.3.8.103 Port/Radio/Ch: dap 1/1/1 Mac: 00:0b:0e:76:56:82
  Device-type: interfering Adhoc: no Crypto-types: clear
  RSSI: -76 SSID: 3Com-webaaa
```

Two types of information are shown. The lines that are not indented show the BSSID, vendor, and information about the SSID. The indented lines that follow this information indicate the listeners (MAP radios) that detected the SSID. Each set of indented lines is for a separate MAP listener.

In this example, two BSSIDs are mapped to the SSID. Separate sets of information are shown for each of the BSSIDs, and information about the listeners for each BSSID is shown.

The following command displays detailed information for a BSSID.

```
WX1200# display rfdetect mobility-domain bssid 00:0b:0e:00:04:d1
BSSID: 00:0b:0e:00:04:d1 Vendor: Cisco SSID: notmycorp
Type: rogue Adhoc: no Crypto-types: clear

  WX1200-IPaddress: 10.8.121.102 Port/Radio/Ch: 3/2/56 Mac: 00:0b:0e:00:0a:6b
Device-type: rogue Adhoc: no Crypto-types: clear
RSSI: -72 SSID: notmycorp

  WX1200-IPaddress: 10.3.8.103 Port/Radio/Ch: dap 1/1/157 Mac: 00:0b:0e:76:56:82
  Device-type: rogue Adhoc: no Crypto-types: clear
  RSSI: -72 SSID: notmycorp
```

Displaying RF Detect Data

To display information about the APs detected by an individual WX switch, use the following command:

`display rfdetect data`

You can enter this command on any switch in the Mobility Domain.

```
WX1200# display rfdetect data
Total number of entries: 197
Flags: i = infrastructure, a = ad-hoc
       c = CCMP, t = TKIP, 1 = 104-bit WEP, 4 = 40-bit WEP, w = WEP(non-WPA)
BSSID             Vendor   Type  Port/Radio/Ch Flags  RSSI Age SSID
----------------- -------- ----- ------------- ------ ---- --- ------------------
00:07:50:d5:cc:91   Cisco intfr       3/1/6    i----w  -61   6 r27-cisco1200-2
00:07:50:d5:dc:78   Cisco intfr       3/1/6    i----w  -82   6 r116-cisco1200-2
00:09:b7:7b:8a:54   Cisco intfr       3/1/2    i-----  -57   6
00:0a:5e:4b:4a:c0    3Com intfr       3/1/11   i-----  -57   6 public
00:0a:5e:4b:4a:c2    3Com intfr       3/1/11   i-t1--  -86   6 3Comwlan
00:0a:5e:4b:4a:c4    3Com intfr       3/1/11   ic----  -85   6 3Com-ccmp
00:0a:5e:4b:4a:c6    3Com intfr       3/1/11   i-t---  -85   6 3Com-tkip
00:0a:5e:4b:4a:c8    3Com intfr       3/1/11   i----w  -83   6 3Com-voip
00:0a:5e:4b:4a:ca    3Com intfr       3/1/11   i-----  -85   6 3Com-webaaa
...
```

Displaying the APs Detected by MAP Radio

To display the APs detected by a MAP radio, use any of the following commands:

display rfdetect visible *mac-addr*
display rfdetect visible ap *map-num* [**radio** {**1** | **2**}]
display rfdetect visible dap *dap-num* [**radio** {**1** | **2**}]

To following command displays information about the rogues detected by radio 1 on MAP port 3:

```
WX1200# display rfdetect visible ap 3 radio 1
Total number of entries: 104
Flags: i = infrastructure, a = ad-hoc
       c = CCMP, t = TKIP, 1 = 104-bit WEP, 4 = 40-bit WEP, w = WEP(non-WPA)
Transmit MAC      Vendor   Type  Ch  RSSI Flags  SSID
----------------- -------- ----- --- ---- ------ --------------------------------
00:07:50:d5:cc:91   Cisco intfr   6  -60 i----w r27-cisco1200-2
00:07:50:d5:dc:78   Cisco intfr   6  -82 i----w r116-cisco1200-2
00:09:b7:7b:8a:54   Cisco intfr   2  -54 i-----
00:0a:5e:4b:4a:c0    3Com intfr  11  -57 i----- public
00:0a:5e:4b:4a:c2    3Com intfr  11  -86 i-t1-- 3Comwlan
00:0a:5e:4b:4a:c4    3Com intfr  11  -85 ic---- 3Com-ccmp
```

```
00:0a:5e:4b:4a:c6    3Com intfr  11  -85 i-t--- 3Com-tkip
00:0a:5e:4b:4a:c8    3Com intfr  11  -83 i----w 3Com-voip
00:0a:5e:4b:4a:ca    3Com intfr  11  -85 i----- 3Com-webaaa
...
```

Displaying Countermeasures Information

To display the current status of countermeasures against rogues in the Mobility Domain, use the following command:

`display rfdetect countermeasures`

This command is valid only on the Mobility Domain's seed switch.

```
WX# display rfdetect countermeasures
Total number of entries: 190
Rogue MAC         Type  Countermeasures    WX-IPaddr       AP/Radio
                        Radio Mac                          /Channel
----------------- ----- ------------------ --------------- -------------
00:0b:0e:00:71:c0 intfr 00:0b:0e:44:55:66  10.1.1.23       4/1/6
00:0b:0e:03:00:80 rogue 00:0b:0e:11:22:33  10.1.1.23       2/1/11
```

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MANAGING SYSTEM FILES

A Wireless Switch (WX) contains nonvolatile storage. MSS allows you to manage the files in nonvolatile storage. In addition, you can copy files between the WX switch and a TFTP server on the network.

About System Files

Generally, a WX switch's nonvolatile storage contains the following types of files:

- **System image files** — The operating system software for the WX switch and its attached MAPs
- **Configuration files** — CLI commands that configure the WX switch and its attached MAPs
- **System log files** — Files containing log entries generated by MSS.

When you power on or reset the WX switch or reboot the software, the switch loads a designated system image, then loads configuration information from a designated configuration file.

A WX switch can also contain temporary files with trace information used for troubleshooting. Temporary files are not stored in nonvolatile memory, but are listed when you display a directory of the files on the switch.

Displaying Software Version Information

To display the software, firmware, and hardware versions, use the following command:

```
display version [details]
```

The **details** option displays hardware and software information about the MAPs configured on the WX switch.

To display version information for a WX switch, type the following command:

```
WX# display version
Mobility System Software, Version: 6.0.0.2 REL
        Copyright (c) 2002 - 2006 3Com Corporation. All rights
reserved.
Build Information: (build#0) REL_6_0_0_branch 2006-10-06 23:46:00
                   Model: WX-20
Hardware
   Mainboard:      version 24 ; revision 3 ; FPGA version 24
   PoE board:      version 1 ; FPGA version 6
Serial number      0321300013
Flash:             6.1.0.5 - md0a
Kernel:            3.0.0#14: Sat Oct 7 00:03:52 PDT 2006
BootLoader:        6.0 / 6.0.6
```

To also display MAP information, type the following command:

```
WX# display version details
Mobility System Software, Version: 6.0.0.2 REL
         Copyright (c) 2002 - 2006 3Com Corporation. All rights
reserved.
Build Information: (build#0) REL_6_0_0_branch 2006-10-06 23:46:00
Label:              REL_6.0.0.2.0_100606
Build Suffix:      -d-O1
Model:              WX-20
Hardware
   Mainboard:       version 24 ; revision 3 ; FPGA version 24
   CPU Model:       750 (Revision 3.1)
   PoE board:       version 1 ; FPGA version 6
   Serial number    0321300013
   Flash:           6.1.0.5 - md0a
   Kernel:          3.0.0#14: Sat Oct 7 00:03:52 PDT 2006
   BootLoader:      6.0 / 6.0.6
   AP    AP Model   Serial #     Versions
   ----- ---------- ------------ ------------------------
       7 MP-252     0333703050     H/W : A3
                          F/W1 : 5.6
                          F/W2 : 5.6
                           S/W : 6.0.0.2.0_100606_2346_
                      BOOT S/W : 6.0.0.2.0_100606_2346_
                   fingerprint : (null)
```

(For additional information about the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Displaying Boot Information

Boot information consists of the MSS version and the names of the system image file and configuration file currently running on the WX switch. The **boot** command also lists the system image and configuration file that will be loaded after the next reboot. The currently running versions are listed in the Booted fields. The versions that will be used after the next reboot are listed in the Configured fields.

To display boot information, type the following command:

```
WX1200# display boot
Configured boot version:          4.1.0.65
Configured boot image:            boot1:wxb04102.rel
Configured boot configuration:    file:configuration
Backup boot configuration:        file:backup.cfg
Booted version:                   4.1.0.65
Booted image:                     boot1:wxb04102.rel
Booted configuration:             file:configuration
Product model:                    WX
```

In this example, the switch is running software version 4.1.0.65. The switch used the wxb04102.rel image file in boot partition boot1 and the *configuration* configuration file for the most recent reboot. The switch is set to use image file *WX040100.020* in boot partition boot1 and configuration file *configuration* for the next reboot. If MSS cannot read the *configuration* file when the switch is booted, then the configuration file *backup.cfg* is used instead.

Each time the WX switch successfully loads an MSS software image, a reference to this image is saved as the "safe boot" image. If the MSS software cannot be loaded the next time the WX switch is booted, then the WX switch automatically attempts to load the safe boot image.

Boot failover might occur when an image update is attempted, and the update process fails. For example, with image A loaded on the WX switch, you can configure the WX switch to load image B the next time the switch is booted. When the switch is reset, if image B fails to load, the switch then attempts to load image A (the last image successfully loaded on the WX switch).

(For additional information about the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Working with Files

The following section describe how to manage files stored on the WX switch.

Displaying a List of Files

Files are stored on a WX switch in the following areas:

- **File** — Contains configuration files
- **Boot** — Contains system image files
- **Temporary** — Contains log files and other files created by MSS

The file and boot areas are in nonvolatile storage. Files in nonvolatile storage remain in storage following a software reload or power cycle. The files in the temporary area are removed following a software reload or power cycle.

The boot area is divided into two partitions, boot0 and boot1. Each partition can contain one system image file.

The file area can contain subdirectories. Subdirectory names are indicated by a forward slash at the end of the name. In the following example, *dangdir* and *old* are subdirectories.

To display a list of the files in nonvolatile storage and temporary files, type the following command:

```
WX1200# dir
===============================================================================
file:
Filename                                        Size           Created
file:configuration                              48 KB      Jul 12 2005, 15:02:32
file:corp2:corp2cnfig                           17 KB      Mar 14 2005, 22:20:04
corp_a/                                        512 bytes   May 21 2004, 19:15:48
file:dangcfg                                    14 KB      Mar 14 2005, 22:20:04
old/                                           512 bytes   May 16 2004, 17:23:44
file:pubsconfig-april062005                     40 KB      May 09 2005, 21:08:30
file:sysa_bak                                   12 KB      Mar 15 2005, 19:18:44
file:testback                                   28 KB      Apr 19 2005, 16:37:18
Total:         159 Kbytes used, 207663 Kbytes free
```

```
===============================================================================
Boot:
Filename                                        Size           Created
boot0:WXA30001.Rel                            9780 KB      Aug 23 2005, 15:54:08
*boot1:WXA40101.Rel                           9796 KB      Aug 28 2005, 21:09:56
Boot0: Total:        9780 Kbytes used, 2460 Kbytes free
Boot1: Total:        9796 Kbytes used, 2464 Kbytes free
===============================================================================
temporary files:
Filename                                        Size           Created
core:command_audit.cur                          37 bytes   Aug 28 2005, 21:11:41
Total:          37 bytes used, 91707 Kbytes free
```

The following command displays the files in the *old* subdirectory:

```
WX1200# dir old
===============================================================================
file:
Filename                                        Size           Created
file:configuration.txt                        3541 bytes   Sep 22 2003, 22:55:44
file:configuration.xml                          24 KB      Sep 22 2003, 22:55:44
Total:          27 Kbytes used, 207824 Kbytes free
```

The following command limits the output to the contents of the user files area:

```
WX1200# dir file:
===============================================================================
file:
Filename                                        Size           Created
file:configuration                              48 KB      Jul 12 2005, 15:02:32
file:corp2:corp2cnfig                           17 KB      Mar 14 2005, 22:20:04
corp_a/                                        512 bytes   May 21 2004, 19:15:48
file:dangcfg                                    14 KB      Mar 14 2005, 22:20:04
dangdir/                                       512 bytes   May 16 2004, 17:23:44
file:pubsconfig-april062005                     40 KB      May 09 2005, 21:08:30
file:sysa_bak                                   12 KB      Mar 15 2005, 19:18:44
file:testback                                   28 KB      Apr 19 2005, 16:37:18
Total:         159 Kbytes used, 207663 Kbytes free
```

The following command limits the output to the contents of the */tmp/core* subdirectory:

```
WX1200# dir core:
===============================================================================
file:
Filename                                                Size          Created
core:command_audit.cur                                  37 bytes   Aug 28 2005, 21:11:41
Total:          37 bytes used, 91707 Kbytes free
```

The following command limits the output to the contents of the *boot0* partition:

```
WX1200# dir boot0:
===============================================================================
file:
Filename                                                Size          Created
boot0:WXA30001.Rel                                    9780 KB      Aug 23 2005, 15:54:08
Total:        9780 Kbytes used, 207663 Kbytes free
```

(For information about the fields in the output, see the *Wireless LAN Switch and Controller Command Reference*.)

Copying a File

You can perform the following copy operations:

- Copy a file from a TFTP server to nonvolatile storage.
- Copy a file from nonvolatile storage or temporary storage to a TFTP server.
- Copy a file from one area in nonvolatile storage to another.
- Copy a file to a new filename in nonvolatile storage.

To copy a file, use the following command.

`copy source-url destination-url`

A URL can be one of the following:

- [*subdirname***/**]*filename*
- **file:**[*subdirname***/**]*filename*
- **tftp://***ip-addr***/**[*subdirname***/**]*filename*
- **tmp:***filename*

The *filename* and **file:***filename* URLs are equivalent. You can use either URL to refer to a file in a WX switch's nonvolatile memory.

The **tftp://***ip-addr***/***filename* URL refers to a file on a TFTP server. If DNS is configured on the WX switch, you can specify a TFTP server's hostname as an alternative to specifying the IP address.

The **tmp:***filename* URL refers to a file in temporary storage. You can copy a file out of temporary storage but you cannot copy a file into temporary storage.

The *subdirname/* option specifies a subdirectory.

If you are copying a system image file into nonvolatile storage, the *destination-url* must include the boot partition name. You can specify one of the following:

- **boot0:/***filename*
- **boot1:/***filename*

You must specify the boot partition that *was not* used to load the currently running image.

The maximum supported file size for TFTP is 32 MB.

You can copy a file from a WX switch to a TFTP server or from a TFTP server to a WX switch, but you cannot use MSS to copy a file directly from one TFTP server to another.

To copy the file *floor2wx* from nonvolatile storage to a TFTP server, type the following command:

```
WX1200# copy floor2wx tftp://10.1.1.1/floor2wx
success: sent 365 bytes in 0.401 seconds [ 910 bytes/sec]
```

The above command copies the file to the same filename on the TFTP server. To rename the file when copying it, type the following command:

```
WX1200# copy floor2wx tftp://10.1.1.1/floor2wx-backup
success: sent 365 bytes in 0.401 seconds [ 910 bytes/sec]
```

To copy a file named *newconfig* from a TFTP server to nonvolatile storage, type the following command:

```
WX1200# copy tftp://10.1.1.1/newconfig newconfig
success: received 637 bytes in 0.253 seconds [ 2517
bytes/sec]
```

The above command copies the file to the same filename. To rename the file when copying it, type the following command:

```
WX1200# copy tftp://10.1.1.1/newconfig wxconfig
success: received 637 bytes in 0.253 seconds [ 2517
bytes/sec]
```

To copy system image *wxb04102.rel* from a TFTP server to boot partition 1 in nonvolatile storage, type the following command:

```
WX1200# copy tftp://10.1.1.107/wxb04102.rel boot1:wxb04102.rel
..................................................................
...........................success: received 9163214 bytes in 105.939 seconds
[ 86495 bytes/sec]
```

To rename *test-config* to *new-config*, you can copy it from one name to the other in the same location, and then delete *test-config*. Type the following commands:

```
WX1200# copy test-config new-config
WX1200# delete test-config
success: file deleted.
```

To copy file *corpa-login.html* from a TFTP server into subdirectory *corpa* in a WX switch's nonvolatile storage, type the following command:

```
WX1200# copy tftp://10.1.1.1/corpa-login.html corpa/corpa-login.html
success: received 637 bytes in 0.253 seconds [ 2517 bytes/sec]
```

Using an Image File's MD5 Checksum To Verify Its Integrity

If you download an image file from the 3Com support site and install it in a switch's boot partition, you can verify that the file has not been corrupted while being copied.

```
md5 [boot0: | boot1:]filename
```

To verify an image file's integrity:

1. Download the image file from the 3Com support site onto a TFTP server, and use the CLI **copy tftp** command on the WX switch to copy the image onto the switch's nonvolatile storage.
2. On the 3Com support site, click on the MD5 link next to the link for the image file, to display the MD5 checksum for the file. Here is an example:

```
b9cf7f527f74608e50c70e8fb896392a wxb04102.rel
```

3. On the WX switch, use the **dir** command to display the contents of nonvolatile storage.

4. Enter a command such as the following to calculate the checksum for the file:

```
WX1200# md5 boot0:wxb04102.rel
MD5 (boot0:WX040003.020) = b9cf7f527f74608e50c70e8fb896392a
```

You must include the boot partition name in the filename. For example, you must specify boot0:WX040003.020. If you specify only WX040003.020, the CLI displays a message stating that the file does not exist.

5. Compare the checksum on the support site with the checksum calculated by the WX switch. If they match, then the file has not been corrupted.
6. If you have not already done so, use the **set boot partition** command to configure the WX to boot from the partition containing the new image.
7. Use the **reset system [force]** command to restart the switch using the new image.

Deleting a File

Use the **delete url** command to remove a file.

WARNING: *MSS does not prompt you to verify whether you want to delete a file. When you press Enter after typing a* ***delete*** *command, MSS immediately deletes the specified file. 3Com recommends that you copy a file to a TFTP server before deleting the file.*

MSS does not allow you to delete the currently running software image file or the running configuration.

To delete a file, use the following command:

```
delete url
```

The URL can be a filename of up to 128 alphanumeric characters.

To copy a file named *testconfig* to a TFTP server and delete the file from nonvolatile storage, type the following commands:

```
WX1200# copy testconfig tftp://10.1.1.1/testconfig
success: sent 365 bytes in 0.401 seconds [ 910 bytes/sec]
WX1200# delete testconfig
success: file deleted.
```

Creating a Subdirectory

You can create subdirectories in the user files area of nonvolatile storage. To create a subdirectory, use the following command:

```
mkdir [subdirname]
```

To create a subdirectory called *corp2* and display the root directory to verify the result, type the following commands:

```
WX1200# mkdir corp2
success: change accepted.
WX1200# dir
===============================================================================
file:
Filename                                        Size           Created
file:configuration                              17 KB      May 21 2004, 18:20:53
file:configuration.txt                         379 bytes   May 09 2004, 18:55:17
corp2/                                      512 bytes   May 21 2004, 19:22:09
corp_a/                                     512 bytes   May 21 2004, 19:15:48
file:dangcfg                                    13 KB      May 16 2004, 18:30:44
dangdir/                                   512 bytes   May 16 2004, 17:23:44
old/                                       512 bytes   Sep 23 2003, 21:58:48
Total:         33 Kbytes used, 207822 Kbytes free
===============================================================================
Boot:
Filename                                        Size           Created
*boot0:bload                                   746 KB      May 09 2004, 19:02:16
*boot0:WXB03002.Rel                           8182 KB      May 09 2004, 18:58:16
boot1:WXB03001.Rel                            8197 KB      May 21 2004, 18:01:02
Boot0: Total:        8928 Kbytes used, 3312 Kbytes free
Boot1: Total:        8197 Kbytes used, 4060 Kbytes free
===============================================================================
temporary files:
Filename                                        Size           Created
Total:        0 bytes used, 93537 Kbytes free
```

Removing a Subdirectory

To remove a subdirectory from nonvolatile storage, use the following command:

```
rmdir [subdirname]
```

To remove subdirectory *corp2*, type the following example:

```
WX1200# rmdir corp2
success: change accepted.
```

Managing Configuration Files

A configuration file contains CLI commands that set up the WX switch. The switch loads a designated configuration file immediately after loading the system software when the software is rebooted. You also can load a configuration file while the switch is running to change the switch's configuration.

When you enter CLI commands to make configuration changes, these changes are immediately added to the device's running configuration but are not saved to the configuration file.

This section describes how to display the running configuration and the configuration file, and how to save and load configuration changes. A procedure is also provided for resetting the WX switch to its factory default configuration.

Displaying the Running Configuration

To display the configuration running on the WX switch, use the following command:

```
display config [area area] [all]
```

The **area** *area* parameter limits the display to a specific configuration area. (For more information, see the *Wireless LAN Switch and Controller Command Reference*.)

The **all** parameter includes all commands that are set at their default values. Without the **all** parameter, the **display config** command lists only those configuration commands that set a parameter to a value other than the default.

To display the running configuration, type the following command:

```
WX1200# display config
# Configuration nvgen'd at 2004-5-10 19:08:38
# Image 2.1.0
# Model WX1200
# Last change occurred at 2004-5-10 16:31:14
set trace authentication level 10
set ip dns server 10.10.10.69 PRIMARY
set ip dns server 10.20.10.69 SECONDARY
set ip route default 10.8.1.1 1
set log console disable severity debug
set log session disable severity alert
set log buffer enable severity error messages 200
set log trace disable severity error mbytes 10
set log server 192.168.253.11 severity critical
set timezone PST -8 0
set summertime PDT start first sun apr 2 0 end lastsun oct 2 0
set system name WX1200
set system countrycode US
set system contact 3Com-pubs
set radius server r1 address 192.168.253.1 key sunflower
set server group sg1 members r1
set enablepass password b6b706525e1814394621eeb2a1c4d5803fcf
set authentication console * none
set authentication admin * none
set user tech password encrypted 1315021018
press any key to continue, q to quit.
```

To display only the VLAN configuration commands, type the following command:

```
WX1200# display config area vlan
# Configuration nvgen'd at 2004-5-10 19:08:38
# Image 2.1.0
# Model WX1200
# Last change occurred at 2004-5-10 16:31:14
set vlan 1 port 1
set vlan 10 name backbone tunnel-affinity 5
set vlan 10 port 7
set vlan 10 port 8
set vlan 3 name red tunnel-affinity 5
set igmp mrsol mrsi 60 vlan 1
set igmp mrsol mrsi 60 vlan 10
```

Saving Configuration Changes

To save the running configuration to a configuration file, use the following command:

save config [*filename*]

If you do not specify a filename of up to 128 alphanumeric characters, the command replaces the startup configuration file that was loaded the last time the software was rebooted. (To display the filename of that configuration file, see “Displaying Boot Information” on page 601.)

To save the running configuration to the file loaded the last time the software was rebooted, type the following command:

```
WX1200# save config
success: configuration saved.
```

To save the running configuration to a file named *newconfig*, type the following command:

```
WX1200# save config newconfig
success: configuration saved to newconfig.
```

Specifying the Configuration File to Use After the Next Reboot

By default, the WX switch loads the configuration file named *configuration* from nonvolatile storage following a software reboot. To use a different configuration file in nonvolatile storage after rebooting, use the following command:

```
set boot configuration-file filename
```

To configure a WX switch to load the configuration file *floor2wx* from nonvolatile storage following the next software reboot, type the following command:

```
WX1200# set boot configuration-file floor2wx
success: boot config set.
```

Loading a Configuration File

To load configuration commands from a file into the WX switch's running configuration, use the **load config** command.

WARNING: *This command completely removes the running configuration and replaces it with the configuration contained in the file. 3Com recommends that you save a copy of the current running configuration to a backup configuration file before loading a new configuration.*

```
load config [url]
```

The default URL is the name of the configuration file loaded after the last reboot.

To load a configuration file named *newconfig*, type the following command:

```
WX1200# load config newconfig
Reloading configuration may result in lost of connectivity,
do you wish to continue? (y/n) [n]y
success: Configuration reloaded
```

After you type **y**, MSS replaces the running configuration with the configuration in the *newconfig* file. If you type **n**, MSS does not load the *newconfig* file and the running configuration remains unchanged.

Specifying a Backup Configuration File

In the event that part of the configuration file is invalid or otherwise unreadable, MSS stops reading information in the configuration file and does not use it. You can optionally specify a backup file to load if MSS cannot load the original configuration file.

To specify a backup configuration file, use the following command:

```
set boot backup-configuration filename
```

To specify a file called *backup.cfg* as the backup configuration file, use the following command:

```
WX1200# set boot backup-configuration backup.cfg
success: backup boot config filename set.
```

After enabling this feature, you can specify that a backup configuration file not be used by entering the following command:

```
WX1200# clear boot backup-config
success: Backup boot config filename was cleared.
```

To display the name of the file specified as the backup configuration file, enter the **display boot** command. For example:

```
WX1200# display boot
Configured boot version:         4.1.0.60
Configured boot image:        wxb04102.rel
Configured boot configuration:   file:configuration
Backup boot configuration:       backup.cfg
Booted version:                  4.1.0.60
Booted image:                 wxb04102.rel
Booted configuration:            file:configuration
Product model:                   WX
```

Resetting to the Factory Default Configuration

To reset the WX switch to its factory default configuration, use the following command:

```
clear boot config
```

This command removes the configuration file that the WX switch searches for after the software is rebooted.

To back up the current configuration file named *configuration* and reset the WX switch to the factory default configuration, type the following commands:

```
WX1200# copy configuration tftp://10.1.1.1/backupcfg
success: sent 365 bytes in 0.401 seconds [ 910 bytes/sec]
WX1200# clear boot config
success: Reset boot config to factory defaults.
WX1200# reset system force
...... rebooting ......
```

The **reset system force** command reboots the switch. The **force** option immediately restarts the system and reboots. If you do not use the **force** option, the command first compares the running configuration to the configuration file. If the files do not match, MSS does not restart the WX switch but instead displays a message advising you to either save the configuration changes or use the **force** option.

Backing Up and Restoring the System

MSS has commands that enable you to easily backup and restore WX system and user files:

```
backup system [tftp:/ip-addr/]filename [all | critical]
restore system [tftp:/ip-addr/]filename [all | critical]
[force]
```

The **backup** command creates an archive in Unix *tape archive* (*tar*) format.

The **restore** command unzips an archive created by the **backup** command and copies the files from the archive onto the switch. If a file in the archive has a counterpart on the switch, the archive version of the file replaces the file on the switch. The **restore** command does not delete files that do not have counterparts in the archive. For example, the command does not completely replace the user files area. Instead, files in the archive are added to the user files area. A file in the user area is replaced only if the archive contains a file with the same name.

You can create or unzip an archive located on a TFTP server or in the switch's nonvolatile storage. If you specify a TFTP server as part of the filename with the **backup** command, the archive is copied directly to the TFTP server and not stored locally on the switch.

Both commands have options to specify the types of files you want to back up and restore:

- **critical**—Backs up or restores system files, including the configuration file used when booting, and certificate files. The size of an archive created by this option is generally 1MB or less. This is the default for the **restore** command.
- **all**—Backs up or restores the same files as the **critical** option, ***and*** all files in the user files area of nonvolatile storage. (The user files area contains the set of files listed in the *file* section of **dir** command output.) Archive files created by the **all** option are larger than files created by the **critical** option. The file size depends on the files in the user area, and the file can be quite large if the user area contains image files. This is the default for the **backup** command.

If the archive's files cannot fit on the switch, the restore operation fails. 3Com recommends deleting unneeded image files before creating or restoring an archive.

Use the **critical** option if you want to back up or restore only the system-critical files required to operate and communicate with the switch. Use the **all** option if you also want to back up or restore WebAAA pages, backup configuration files, image files, and any other files stored in the user files area of nonvolatile storage.

The maximum supported file size is 32 MB. If the file size of the tarball is too large, delete unnecessary files (such as unneeded copies of system image files) and try again, or use the **critical** option instead of the **all** option.

Neither option archives image files or any other files listed in the *Boot* section of **dir** command output. The **all** option archives image files only if they are present in the user files area.

The **backup** command stores the MAC address of the switch in the archive. By default, the **restore** command works only if the MAC address in the archive matches the MAC address of the switch where the **restore** command is entered. The **force** option overrides this restriction and allows you to unpack one switch's archive onto another switch.

CAUTION: *Do not use the force option unless advised to do so by 3Com. If you restore one switch's system files onto another switch, you must generate new key pairs and certificates on the switch.*

Managing Configuration Changes

The **backup** command places the boot configuration file into the archive. (The boot configuration file is the *Configured boot configuration* in the **display boot** command's output.) If the running configuration contains changes that have not been saved, these changes are not in the boot configuration file and are not archived. To make sure the archive contains the configuration that is currently running on the switch, use the **save config** command to save the running configuration to the boot configuration file, before using the **backup** command.

The **restore** command replaces the boot configuration on the switch with the one in the archive. The boot configuration includes the configuration filename and the image filename to use after the next switch restart. (These are the *Configured boot image* and *Configured boot configuration* files listed in the **display boot** command's output.) The **restore** command does not affect the running image or the running configuration.

If you want to use the configuration in the boot configuration file restored from an archive instead of the configuration currently running on the switch, use the **load config** command to load the boot configuration file, or restart the switch. If instead, you want to replace the configuration restored from the archive with the running configuration, use the **save config** command to save the running configuration to the boot configuration file.

The next time the switch is restarted after the restore command is used, the switch uses the boot configuration filename that was in use when the archive was created. If you change the boot configuration filename after creating the archive, the new name is not used when the switch is restarted. To use the new configuration, use the save config filename command, where filename is the name of the boot configuration file restored from the archive, before you restart the switch. If you have already restarted the switch, use the load config filename command to load the new configuration, then use the save config filename command.

Backup and Restore Examples

The following command creates an archive of the system-critical files and copies the archive directly to a TFTP server. The filename in this example includes a TFTP server IP address, so the archive is not stored locally on the switch.

```
WX1200# backup system tftp:/10.10.20.9/sysa_bak critical
success: sent 28263 bytes in 0.324 seconds [ 87231 bytes/sec]
```

The following command restores system-critical files on a switch, from archive *sysa_bak*:

```
WX1200# restore system tftp:/10.10.20.9/sysa_bak
success: received 11908 bytes in 0.150 seconds [ 79386
bytes/sec]
success: restore complete.
```

Upgrading the System Image

To upgrade the WX switch from one MSS version to another, use the procedure in this section. For a given release, there may be notes and cautions that apply only to that release. Consequently, before upgrading to a new software image, you should also consult the release notes for that release.

Preparing the WX Switch for the Upgrade

Use the following command to save the configuration. Unsaved changes will be lost during the upgrade procedure.

```
save config [filename]
```

CAUTION: *Save the configuration, then create a backup of your WX switch files before you upgrade the switch. 3Com recommends that you make a backup of the switch files before you install the upgrade. If an error occurs during the upgrade, you can restore your switch to its previous state.*

If the switch is running MSS Version 3.2.2 or later, you can use the following command to back up the switch's files:

```
backup system [tftp:/ip-addr/]filename [all | critical]
```

To restore a switch that has been backed up, use the following command:

```
restore system [tftp:/ip-addr/]filename [all | critical] [force]
```

"Upgrade Scenario" on page 618 shows an example use of the **backup** command. For more information about these commands, see "Backing Up and Restoring the System" on page 613.

If you have made configuration changes but have not saved the changes, use the save config command to save the changes, before you back up the switch.

If the switch is running a version of MSS earlier than 3.2.2, use the **copy tftp** command to copy files from the switch onto a TFTP server.

Upgrading an Individual Switch Using the CLI

1. Save the configuration, using the **save config** command.
2. Back up the switch, using the **backup system** command.
3. Copy the new system image onto a TFTP server.

   For example, log in to http://www.3com.com using a web browser on your TFTP server and download the image onto the server.
4. Copy the new system image file from the TFTP server into a boot partition in the switch's nonvolatile storage.

   You can copy the image file only into the boot partition that was *not* used for the most recent restart. For example, if the currently running image was booted from partition 0, you can copy the new image only into partition 1.
5. Set the boot partition to the one with the upgrade image for the next restart.

   To verify that the new image file is installed, type **display boot**.
6. Reboot the software.

   To restart a WX switch and reboot the software, type the following command:

   ```
   reset system [force]
   ```

   When you restart the WX switch, the switch boots using the new MSS image. The switch also sends the MAP version of the new boot image to MAPs and restarts the MAPs. After a MAP restarts, it checks the version of the new MAP boot image to make sure the boot image is newer than the boot image currently installed on the MAP. If the boot image is newer, the MAP completes installation of its new boot image by copying the boot image into the MAP's flash memory, which takes about 30 seconds, then restarts again. The upgrade of the MAP is complete after the second restart.

Upgrade Scenario

To upgrade a WX1200 switch from MSS Version 4.0 to MSS Version 4.1, type the following commands.

This example copies the image file into boot partition 1. On your switch, copy the image file into the boot partition that was not used the last time the switch was restarted. For example, if the switch booted from boot partition 1, copy the new image into boot partition 0. To see boot partition information, type the display boot command.

```
WX1200# save config
success: configuration saved.
WX1200# backup system tftp://172.16.0.10/sysa_bak
success: sent 13628 bytes in 0.150 seconds [ 90853 bytes/sec]
success: received 13628 bytes in 0.146 seconds [ 93342 bytes/sec]
success: backup complete.
WX1200# copy tftp://172.16.0.10/WX040101.20 boot1:WX040100.20
.........................................success: received 6319102 bytes in
75.292 seconds [ 83927 bytes/sec]
WX1200# set boot partition boot1
success: Boot partition set to boot1.
WX1200# display boot
Configured boot version:         4.1.1.1
Configured boot image:           boot1:WX040100.20
Configured boot configuration:   file:configuration
Backup boot configuration:       backup
Booted version:                  4.0.0.15
Booted image:                    boot0:WX040015.20
Booted configuration:            file:configuration
Product model:                   WX1200
WX1200# reset system
This will reset the entire system. Are you sure (y/n) y
...... rebooting ......
```

Command Changes During Upgrade

When you upgrade a WX switch, some commands from the previously installed release may have been deprecated or changed in the new release, which may affect your configuration. For information about commands that were deprecated or changed from a previous release, see the release notes for the release you are installing.

A

TROUBLESHOOTING A WX SWITCH

Some common problems that occur during WX installation and basic configuration are simple to solve. However, to “recover” the system password, you must delete the existing WX configuration.

Fixing Common WX Setup Problems

System logs provide a history of MSS events. Traces display real-time messages from all MSS areas. Some **display** commands are particularly useful in troubleshooting. The **display base-information** command combines a number of **display** commands into one, and provides an extensive snapshot of your WX switch configuration settings for 3Com technical support.

Table 51 contains remedies for some common problems that can occur during basic installation and setup of a WX switch.

Table 51 WX Setup Problems and Remedies

Symptom	Diagnosis	Remedy
3Com Wireless Switch Manager or a web browser (if you are using Web Manager) warns that the WX switch's certificate date is invalid.	The switch's time and date are currently incorrect, or were incorrect when you generated the self-signed certificate or certificate request.	**1** Use **set timezone** to set the time zone in which you are operating the switch. (See "Setting the Time Zone" on page 125.) **2** Use **set timedate** to configure the current time and date in that time zone. (See "Statically Configuring the System Time and Date" on page 127.) **3** Reconfigure the administrative certificate(s). (See Chapter 20, "Managing Keys and Certificates," on page 413.) **4** If you have already configured a certificate on the switch for authentication by network users, you must recreate this certificate, too.
WX switch does not accept configuration information for a MAP or a radio.	The country code might not be set or might be set for another country.	**1** Type the **display system** command to display the country code configured on the switch. **2** If the value in the System Countrycode field is *NONE* or is for a country other than the one in which you are operating the switch, use the **set system countrycode** command to configure the correct country code. (See "Specifying the Country of Operation" on page 213.)

Table 51 WX Setup Problems and Remedies (continued)

Symptom	Diagnosis	Remedy
Client cannot access the network.	This symptom has more than one possible cause:	
	▪ The client might be failing authentication or might not be authorized for a VLAN.	**1** Type the **display aaa** command to ensure that the authentication rules on the WX switch allow the client to authenticate. (See "Displaying the AAA Configuration" on page 507.) **2** Check the authorization rules in the switch's local database (**display aaa**) or on the RADIUS servers to ensure the client is authorized to join a VLAN that is configured on at least one of the WX switches in the Mobility Domain. (See "Assigning Authorization Attributes" on page 487.)
	▪ If the client and switch configurations are correct, a VLAN might be disconnected. A client connected to a disconnected VLAN is unable to access the network.	**1** Type the **display vlan config** command to check the status of each VLAN. **2** If a VLAN is disconnected (VLAN state is Down), check the network cables for the VLAN's ports. At least one of the ports in a VLAN must have a physical link to the network for the VLAN to be connected.
Configuration information disappears after a software reload.	The configuration changes were not saved.	**1** Retype the commands for the missing configuration information. **2** Type the **save config** command to save the changes.
Mgmt LED is quickly blinking amber. CLI stops at boot prompt (`boot>`).	The WX switch was unable to load the system image file.	Type the **boot** command at the boot prompt.

Recovering the System When the Enable Password is Lost

You can recover any model switch if you have lost or forgotten the enable password. You also can recover a WXR100 even if you have lost or forgotten the login password.

Recovering the system will delete your configuration file

To recover a WX switch, use one of the following procedures.

WXR100

To recover a WXR100 switch:

1. After the switch has fully booted, use a pin to press the factory reset switch for at least 5 seconds. This operation erases the switch's configuration.
2. Use a web browser to access IP address 192.168.100.1. This address accesses the Web Quick Start.
3. Use the Web Quick Start to set the administrator usernames and passwords and other parameters. Make sure you reconfigure the switch's IP connection.
4. See "First-Time Configuration via the Console" on page 55.

WX1200, WX2200, or WX4400

You set the WX switch password using the **set enablepass** command. If you forget the password, follow these steps:

1. Interrupt the WX switch boot process.

   Power the WX switch off and on again to cause the WX switch to reboot. When you see descending numbers on the console, press any key.
2. When you see descending numbers on the console, press **q**, then press Enter.
3. Type the following command at the boot**>** prompt:

   ```
   boot> boot OPT+=default
   ```

   If you do not type the command before the reset cycle is complete, the WX switch returns to the state it was in before you restarted it.

Once you have entered the command, the WX switch returns to its initial unconfigured state. For information on how to configure the WX switch, see "First-Time Configuration via the Console" on page 55.

CAUTION: *Use an enable password that you will remember. If you lose the password, the only way to restore it causes the system to return to its default settings and wipes out the configuration.*

Configuring and Managing the System Log

System logs provide information about system events that you can use to monitor and troubleshoot MSS. Event messages for the WX switch and its attached MAPs can be stored or sent to the following destinations:

- Stored in a local buffer on the WX
- Displayed on the WX console port
- Displayed in an active Telnet session
- Sent to one or more syslog servers, as specified in RFC 3164

The system log is a file in which the newest record replaces the oldest. These entries are preserved in nonvolatile memory through system reboots.

Log Message Components

Each log message contains the components shown in Table 52.

Table 52 Log Message Components

Field	Description
Facility	Portion of MSS that is affected
Date	Time and date the message is generated
Severity	Severity level of the message. (See Table 54, "Event Severity Levels," on page 624.)
Tag	Identifier for the message
Message	Description of the error condition

Logging Destinations and Levels

A logging destination is the location to which logged event messages are sent for storage or display. By default, only session logging is disabled. You can enable or disable logging to each destination and filter the messages by the severity of the logged event or condition. (For details, see Table 54, "Event Severity Levels," on page 624.)

System events and conditions at different severity levels can be logged to multiple destinations. By default, events at the error level and higher are posted to the console and to the log buffer. Debug output is logged to the trace buffer by default. Table 53 summarizes the destinations and defaults for system log messages.

Table 53 System Log Destinations and Defaults

Destination	Definition	Default Operation and Severity Level
buffer	Sends log information to the nonvolatile system buffer.	Buffer is enabled and shows error-level events.
console	Sends log information to the console.	Console is enabled and shows error-level events.
current	Sends log information to the current Telnet or console session.	Settings for the type of session that the user is currently having with the WX
server *ip-address*	Sends log information to the syslog server at the specified IP address.	Server is set during configuration and displays error-level events.
sessions	Sets defaults for Telnet sessions.	Logging is disabled and shows information-level events when enabled.
trace	Sends log information to the volatile trace buffer.	Trace is enabled and shows debug output.

Specifying a severity level sends log messages for events or conditions at that level or higher to the logging destination. Table 54 lists the severity levels and their descriptions. (For defaults, see Table 53, "System Log Destinations and Defaults," on page 624.)

Table 54 Event Severity Levels

Severity	Description
emergency	The WX switch is unusable.
alert	Action must be taken immediately.
critical	You must resolve the critical conditions. If the conditions are not resolved, the WX can reboot or shut down.
error	The WX is missing data or is unable to form a connection.
warning	A possible problem exists.

Table 54 Event Severity Levels (continued)

Severity	Description
notice	Events that potentially can cause system problems have occurred. These are logged for diagnostic purposes. No action is required.
info	Informational messages only. No problem exists.
debug	Output from debugging. The debug level produces a lot of messages, many of which can appear to be somewhat cryptic. Debug messages are used primarily by 3Com for troubleshooting and are not intended for administrator use.

Using Log Commands

To enable, disable, or modify system logging to the WX switch's log buffer, console, current Telnet session, or trace buffer, use the following command:

```
set log {buffer | console | current | sessions | trace}
[severity severity-level] [enable | disable]
```

To configure system logging to a syslog server, use the following command:

```
set log server ip-addr [port port-number] severity
severity-level [local-facility facility-level]
```

To enable periodic mark messages for use in troubleshooting, use the following command:

```
set log mark [enable | disable] [severity level]
[interval interval]
```

To view log entries in the system or trace buffer, use the following command:

```
display log buffer | trace
```

To clear log messages from the system or trace buffer, use the following command:

```
clear log buffer | trace
```

To stop sending messages to a syslog server, use the following command:

```
clear log server ip-addr
```

Logging to the Log Buffer

The system log consists of rolling entries stored as a last-in first-out queue maintained by the WX. Logging to the buffer is enabled by default for events at the error level and higher.

To modify settings to another severity level, use the following command:

```
set log buffer severity severity-level
```

For example, to set logging to the buffer for events at the warning level and higher, type the following command:

```
WX1200# set log buffer severity warning
success: change accepted.
```

To view log entries in the system log buffer, use the following command:

```
display log buffer [{+|-} number-of-messages]
[facility facility-name] [matching string]
[severity severity-level]
```

You can display the most recent messages or the oldest messages:

- Type a positive number (for example, +100) to display that number of log entries starting from the oldest in the log.
- Type a negative number (for example, -100) to display that number of log entries starting from the newest in the log.

You can search for strings by using the keyword **matching** and typing any string, such as a username or IP address.

You can display event information at a particular severity level. (See Table 54 on page 624 for information on severity levels.)

For example, the following command displays all messages at the error severity level or higher:

```
WX1200# display log buffer severity error
SYS Jun 02 17:41:35. 176214 ERROR nos_vms_port?add:
Failed to set default vlan v1 an:4096 for port 3 rc 1
```

To filter the event log by MSS area, use the **facility** *facility-name* keyword. For a list of facilities for which you can view event messages, type the following command:

```
WX1200# display log buffer facility ?
<facility name>             Select one of: KERNEL, AAA,
SYSLOGD, ACL, APM, ARP, ASO, BOOT, CLI, CLUSTER, CRYPTO,
DOT1X, NET, ETHERNET, GATEWAY, HTTPD, IGMP, IP, MISC, NOSE,
NP, RAND, RESOLV, RIB, ROAM, ROGUE, SM, SNMPD, SPAN, STORE,
SYS, TAGMGR, TBRIDGE, TCPSSL, TELNET, TFTP, TLS, TUNNEL,
VLAN, X509, XML, MAP, RAPDA, WEBVIEW, EAP, FP, STAT, SSHD,
SUP, DNSD, CONFIG, BACKUP.
```

To clear the buffer, type the following command:

```
WX1200# clear log buffer
```

To disable logging to the system buffer, type the following command:

```
WX1200# set log buffer disable
```

Logging to the Console

By default, console logging is enabled and messages at the error level and higher are sent to the console.

To modify console logging, use the following command:

```
set log console severity severity-level
```

(See Table 54 on page 624 for information on severity levels.)

For example, to set logging to the console for events at the critical severity level and higher, type the following command:

```
WX1200# set log console severity critical
success: command accepted.
```

To disable console logging, type the following command:

```
WX1200# set log console disable
success: change accepted.
```

The console is always available, but it has the following limitations:

- Console logging is slow.
- Messages logged to the console are dropped if the console output buffer overflows. MSS displays a message indicating the number of messages dropped.

- If you type anything to the console, the typing disables log output to the console until you press the Enter key.

Logging Messages to a Syslog Server

To send event messages to a syslog server, use the following command:

```
set log server ip-addr [port port-number] severity
severity-level [local-facility facility-level]
```

Use the IP address of the syslog server to which you want messages sent. (See Table 54 on page 624 for information about severity levels.)

By default, MSS uses TCP port 514 for sending messages to the syslog server. You can use the optional **port** keyword to specify a different port for syslog messages. You can specify a number from 1 to 65535.

Use the optional **local-facility** keyword to override the default MSS facility numbers and replace them with one local facility number. Use the numbers 0 through 7 to map MSS event messages to one of the standard local log facilities *local0* through *local7* specified by RFC 3164.

If you do not specify a local facility, MSS sends the messages with their default MSS facilities. For example, AAA messages are sent with facility 4 and boot messages are sent with facility 20 by default.

For example, the following command sends all error-level event messages generated by a WX to a server at IP address 192.168.153.09 and identifies them as facility 5 messages:

```
WX1200# set log server 192.168.153.09 severity error
local-facility 5
success: change accepted.
```

To stop sending log messages to a syslog server, use the following command:

```
clear log server ip-addr
```

Setting Telnet Session Defaults

Session logging is disabled by default, and the event level is set to information (info) or higher. To enable event logging to Telnet sessions and change the default event severity level, use the following command:

```
set log sessions severity severity-level enable
```

(For information on severity levels, see Table 54 on page 624.)

To disable session logging, use the following command:

```
set log sessions disable
```

Changing the Current Telnet Session Defaults

By default, log information is not sent to your current Telnet session, and the log level is set to information (info) or higher. To modify the severity of events logged to your current Telnet session, use the following command from within the session:

```
set log current severity severity-level
```

(For information about severity levels, see Table 54 on page 624.)

To enable current session logging, type the following command:

```
WX1200# set log current enable
success: change accepted
```

To disable current session logging, type the following command:

```
WX1200# set log current disable
success: change accepted
```

Logging to the Trace Buffer

Trace logging is enabled by default and stores debug-level output in the WX trace buffer. To modify trace logging to an event level higher than debug, use the following command:

```
set log trace severity severity-level
```

To disable trace logging, use the following command:

```
set log trace disable
```

(To display the trace log, see “Stopping a Trace” on page 632. For information about the trace function, see “Running Traces” on page 631.)

Enabling Mark Messages

You can configure MSS to generate mark messages at regular intervals. The mark messages indicate the current system time and date. 3Com can use the mark messages to determine the approximate time when a system restart or other event causing a system outage occurred.

Mark messages are disabled by default. When they are enabled, MSS generates a message at the notice level once every 300 seconds by default.

To enable mark messages, use the following command:

```
WX4400# set log mark enable
success: change accepted.
```

Saving Trace Messages in a File

To save the accumulated trace data for enabled traces to a file in the WX switch's nonvolatile storage, use the following command:

```
save trace filename
```

To save trace data into the file *trace1* in the subdirectory *traces*, type the following command:

```
WX1200# save trace traces/trace1
```

Displaying the Log Configuration

To display your current log configuration, type the following command:

```
WX1200# display log config
Logging console:               enabled
Logging console severity:      INFO
Logging sessions:              enabled
Logging sessions severity:     INFO
Logging buffer:                enabled
Logging buffer severity:       ERROR
Logging buffer size:           400 messages
Logging trace:                 enabled
Logging trace severity:        DEBUG
Logging buffer size:           1048576 bytes
Log marking:                   disabled
Log marking severity:          NOTICE
Log marking interval:          300 seconds
Logging server:               172.21.12.19 port 514 severity
EMERGENCY
severity                       CRITICAL
Current session:               disabled
Current session severity:      INFO
```

Running Traces

Trace commands enable you to perform diagnostic routines. You can set a trace command with a keyword, such as **authentication** or **sm**, to trace activity for a particular feature, such as authentication or the session manager.

***WARNING:** Using the **set trace** command can have adverse effects on system performance. 3Com recommends that you use the lowest levels possible for initial trace commands, and slowly increase the levels to get the data you need.*

Using the Trace Command

Tracing is used only for debugging MSS. The command **set trace** *area* enables you to view messages about the status of a specific portion of the MSS.

There are many trace parameters that you can run. (See "List of Trace Areas" on page 634.) However, this chapter describes only authentication, authorization, the session manager (**sm**), and 802.1X users (**dot1x**), four areas that you might find most helpful.

To focus on the object of the trace, you can add one or more of these parameters to the **set trace** command:

```
set trace [area] [mac-addr mac-addr] [port port-num]
[user username] [level level]
```

Tracing Authentication Activity

Tracing authentication activity can help you diagnose authentication problems. You can trace all authentication activity, or only the activity for a specific user, MAC address, or port.

For example, to trace all authentication activity at level 4, type the following command:

```
WX1200# set trace authentication level 4
success: change accepted.
```

Tracing Session Manager Activity

You can trace all session manager commands, or only those for a specific user, MAC address, or port. For example, to trace all session manager (**sm**) activity at level 3, type the following command:

```
WX1200# set trace sm level 3
success: change accepted.
```

Tracing Authorization Activity

Tracing authorization activity can help diagnose authorization problems. For example, to trace the authorization of MAC address 00:00:30:b8:72:b0, type the following command:

```
WX1200# set trace authorization mac-addr 00:00:30:b8:72:b0
success: change accepted.
```

Tracing 802.1X Sessions

Tracing 802.1X sessions can help diagnose problems with wireless clients. For example, to trace 802.1X activity for user tamara@example.com at level 4, type the following command:

```
WX1200# set trace dot1x user tamara@example.com level 4
success: change accepted.
```

Displaying a Trace

Use the **display trace** command to display the trace areas that are enabled. For example, to display all currently running trace commands, type the following command:

```
WX1200# display trace
milliseconds spent printing traces: 31.945
Trace Area           Level Mac               User              Port Filter
-------------------- ----- ----------------- ----------------- ---- --------
authentication           3                   admin                         0
authorization            5                                                 0
sm                       5                                         1       0
dot1x                    2                                                 0
```

Stopping a Trace

The **clear trace** commands deletes running trace commands. To clear all traces or a particular trace area, type the following command:

```
clear trace {all | trace area}
```

(For a list of all areas that can be traced, see “List of Trace Areas” on page 634.)

For example, to stop a trace of session manager activity, type the following command:

```
WX1200# clear trace sm
success: change accepted.
```

About Trace Results

The trace commands use the underlying logging mechanism to deliver trace messages. Trace messages are generated with the debug severity level. By default, the only log target that receives debug-level messages is the volatile trace buffer. (To see the contents of the trace buffer, see "Displaying Trace Results" on page 633.)

The volatile trace buffer receives messages for all log severities when any trace area is active. However, if no trace area is active, no messages are sent to the trace buffer regardless of their severity. If you do not enable trace commands, the trace buffer is effectively disabled.

Because traces use the logging facility, any other logging target can be used to capture trace messages if its severity is set to debug. However, since tracing can be voluminous, 3Com discourages this in practice. To enable trace output to the console, enter the command **set log console severity debug**.

If you attempt to send trace output to a Telnet session, be aware that tracing is disabled for areas processing packets that might be associated with the Telnet session.

Displaying Trace Results

To view the output of currently running trace commands, use the following command:

```
display log trace [{+|-|/}number-of-messages]
[facility facility-name] [matching string]
[severity severity-level]
```

For example, the following command displays a trace log of error-level events:

```
WX1200# display log trace severity error
KERNEL Jan 15 23:08:10 ERROR duplicate IP address
10.7.122.102 sent from link address 00:05:5d:45:ae:cd
```

To display a specific number of trace log messages, you must enter a plus sign (+), minus sign (-), or slash (/) before the number. These characters filter the messages displayed as follows:

- **+***number-of-messages* — Displays the specified number of log entries, starting with the oldest in the log.
- **-***number-of-messages* — Displays the specified number of entries, starting with the newest in the log.

- */number-of-messages* — Displays the specified number of the most recent entries in the log, starting with the least recent.

To filter trace output by MSS area, use the **facility** *facility-name* keyword. For a list of valid facilities for which you can view event messages, type the following command:

```
WX1200# display log trace facility ?
<facility name>             Select one of: KERNEL, AAA,
SYSLOGD, ACL, APM, ARP,ASO, BOOT, CLI,
CLUSTER, CRYPTO, DOT1X, ENCAP,
ETHERNET, GATEWAY, HTTPD, IGMP, IP,
MISC, NOSE, NP, RAND, RESOLV, RIB, ROAM,
ROGUE, SM, SNMPD, SPAN, STORE, SYS,
TAGMGR, TBRIDGE, TCPSSL, TELNET, TFTP,
TLS, TUNNEL, VLAN, X509, XML, MAP, RAPDA,
WEBVIEW, EAP, PORTCONFIG, FP.
```

Copying Trace Results to a Server

To copy the contents of the trace buffer to a file on a TFTP server, use the following command:

```
copy trace-buffer-name tftp://[destination-ip-addr |
destination-hostname]/destination-filename
```

To find the name of the trace buffer file, use the **dir** command.

For example, the following command copies the log messages in trace buffer 0000000001 to a TFTP server at IP address 192.168.253.11, in a file called *log-file*:

```
WX1200# copy 0000000001 tftp://192.168.253.11/log-file
```

Clearing the Trace Log

To clear all messages from the trace log buffer, type the following command:

```
WX1200# clear log trace
```

List of Trace Areas

To see all MSS areas you can trace, type the following command:

```
WX1200# set trace ?
```

Using display Commands

To troubleshoot the WX switch, you can use **display** commands to display information about different areas of the MSS. The following commands can provide helpful information if you are experiencing MSS performance issues.

Viewing VLAN Interfaces

To view interface information for VLANs, type the following command:

```
WX1200# display interface
VLAN Name             Address         Mask            Enabled State
---- ---------------- --------------- --------------- ------- -----
   1 default          0.0.0.0         0.0.0.0         NO      Down
 130 vlan-eng         192.168.12.7    255.255.255.0   YES     Up
 190 vlan-wep         192.168.19.7    255.255.255.0   YES     Up
4094 web-aaa          10.10.10.1      255.255.255.0   YES     Up
```

(For more information about VLAN interfaces, see “Configuring and Managing VLANs” on page 87.)

Viewing AAA Session Statistics

To view AAA session statistics, type the following command:

```
WX1200# display aaa
Default Values
authport=1812 acctport=1813 timeout=5 acct-timeout=5
retrans=3 deadtime=5 key=(null) author-pass=(null)
Radius Servers
Server                  Addr           Ports    T/o Tries Dead State
-------------------------------------------------------------------
SQA2BServer          11.1.1.11       1812 1813  5    3     5    UP
SideShow             192.168.0.21    1812 1813  5    3     0    UP
Server groups
    sg1: SideShow
    SQA: SQA2BServer
set authentication dot1x *@xmpl.com pass-through sg1
set authentication dot1x *@xmpl.com pass-through SQA
set authentication dot1x EXAMPLE\* peap-mschapv2 sg1
user sqa
password = 08325d4f (encrypted)
session-timeout = 3600
mac-user 00:00:a6:47:ad:03
session-timeout = 3600
vlan-name = vlan-wep
mac-user 00:00:65:16:0d:69
session-timeout = 3600
vlan-name = vlan-eng
```

(For more information about AAA, see Chapter 3, "Configuring AAA for Administrative and Local Access," on page 51 and Chapter 21, "Configuring AAA for Network Users," on page 433.)

Viewing FDB Information

The **display fdb** command displays the hosts learned by the WX switch and the ports to which they are connected. To display forwarding database (FDB) information, type the following command:

```
WX1200# display fdb
* = Static Entry. + = Permanent Entry. # = System Entry.
VLAN TAG  Dest MAC/Route Des [CoS]  Destination Ports or VCs/[Protocol Type]
---- ---- ------------------ -----  -----------------------------------------
 130    3 00:05:5d:7e:94:83                  1                       [ALL]
 130  130 00:02:2d:85:6b:4d                  t:192.168.14.6          [ALL]
 130  130 00:0b:0e:12:34:56                  t:192.168.15.5          [ALL]
 130  130 00:0b:0e:02:76:f6                  t:192.168.14.6          [ALL]
 130    2 00:02:2d:86:bd:38                  3                       [ALL]
 130    3 00:05:5d:84:d3:d3                  1                       [ALL]
4097      00:0b:0e:00:04:30     #            CPU                     [ALL]
4096      00:0b:0e:00:04:30     #            CPU                     [ALL]
130      00:0b:0e:00:04:30      #            CPU                     [ALL]
Total Matching FDB Entries Displayed = 32
dynamic = 27, static=0, permanent=0, system=5
```

(For more information about forwarding databases, see "Managing the Layer 2 Forwarding Database" on page 96.)

Viewing ARP Information

The **display arp** command displays the ARP aging timer and ARP entries in the system. To display ARP information, type the following command:

```
WX1200# display arp
ARP aging time: 1200 seconds
Host                           HW Address        VLAN  Type    State
------------------------------ ----------------- ----- ------- --------
10.8.1.1                       00:30:b6:3e:5c:a8     1 DYNAMIC RESOLVED
10.8.107.1                     00:0b:0e:00:04:0c     1 LOCAL   RESOLVED
```

(For more information about ARP, see "Managing the ARP Table" on page 130.)

Port Mirroring

Port mirroring is a troubleshooting feature that copies (mirrors) traffic sent or received by a WX port (the source port) to another WX port (the observer). You can attach a protocol analyzer to the observer port to examine the source port's traffic. Both traffic directions (send and receive) are mirrored.

Port mirroring enables you to snoop traffic on wired ports. To snoop wireless traffic, see "Remotely Monitoring Traffic" on page 638.

Configuration Requirements

- The switch can have one port mirroring pair (one source port and one observer port) at a time.
- The source port can be a network port, MAP access port, or wired authentication port.
- The observer port must be a network port, and cannot be a member of any VLAN or port group.

Configuring Port Mirroring

To configure port mirroring, use the following command to specify the source and observer ports:

```
set port mirror source-port observer observer-port
```

For example, to set port 2 to monitor port 1's traffic, use the following command:

```
WX1200# set port 1 observer 2
```

Attach a protocol analyzer to the observer port; in this example, port 2.

Displaying the Port Mirroring Configuration

To display the port mirroring configuration on a switch, use the following command:

```
WX1200# display port mirror
Port 1 is mirrored to port 2
```

Clearing the Port Mirroring Configuration

To clear the port mirroring configuration from a switch, use the following command:

```
clear port mirror
```

Remotely Monitoring Traffic

Remote traffic monitoring enables you to snoop wireless traffic, by using a MAP as a sniffing device. The MAP copies the sniffed 802.11 packets and sends the copies to an observer, which is typically a protocol analyzer such as Ethereal or Tethereal.

How Remote Traffic Monitoring Works

To monitor wireless traffic, a MAP radio compares traffic sent or received on the radio to snoop filters applied to the radio by the network administrator. When an 802.11 packet matches all conditions in a filter, the MAP encapsulates the packet in a Tazmen Sniffer Protocol (TZSP) packet and sends the packet to the observer host IP addresses specified by the filter. TZSP uses UDP port 37008 for its transport. (TZSP was created by Chris Waters of Network Chemistry.)

You can map up to eight snoop filters to a radio. A filter does not become active until you enable it. Filters and their mappings are persistent and remain in the configuration following a restart. The filter state is also persistent across restarts. Once a filter is enabled, if the switch or the MAP is subsequently restarted, the filter remains enabled after the restart. To stop using the filter, you must manually disable it.

Using Snoop Filters on Radios That Use Active Scan

When active scan is enabled in a radio profile, the radios that use the profile actively scan other channels in addition to the data channel that is currently in use. Active scan operates on enabled radios and disabled radios. In fact, using a disabled radio as a dedicated scanner provides better rogue detection because the radio can spend more time scanning on each channel.

When a radio is scanning other channels, snoop filters that are active on the radio also snoop traffic on the other channels. To prevent monitoring of data from other channels, use the **channel** option when you configure the filter, to specify the channel on which you want to scan.

All Snooped Traffic Is Sent in the Clear

Traffic that matches a snoop filter is copied after it is decrypted. The decrypted (clear) version is sent to the observer.

Best Practices for Remote Traffic Monitoring

- Do not specify an observer that is associated with the MAP where the snoop filter is running. This configuration causes an endless cycle of snoop traffic.
- If the snoop filter is running on a Distributed MAP, and the MAP used a DHCP server in its local subnet to configure its IP information, and the MAP did not receive a default router (gateway) address as a result, the observer must also be in the same subnet. Without a default router (gateway), the MAP cannot find the observer.
- The MAP that is running a snoop filter forwards snooped packets directly to the observer. This is a one-way communication, from the MAP to the observer. If the observer is not present, the MAP still sends the snoop packets, which use bandwidth. If the observer is present but is not listening to TZSP traffic, the observer continuously sends ICMP error indications back to the MAP. These ICMP messages can affect network and MAP performance.

To inform you of this condition, MSS generates a log message such as the following the first time an ICMP error message is received following the start of a snoop filter:

```
MAP Mar 25 13:15:21.681369 ERROR DAP 3 ap_network: Observer
10.10.101.2 is not accepting TZSP packets
```

To prevent ICMP error messages from the observer, 3Com recommends using the Netcat application on the observer to listen to UDP packets on the TZSP port.

Configuring a Snoop Filter

To configure a snoop filter, use the following command:

```
set snoop filter-name [condition-list] [observer ip-addr]
[snap-length num]
```

The *filter-name* can be up to 15 alphanumeric characters.

The *condition-list* specifies the match criteria for packets. Conditions in the list are ANDed. Therefore, to be copied and sent to an observer, a packet must match all criteria in the *condition-list*. You can specify up to eight of the following conditions in a filter, in any order or combination:

```
frame-type {eq | neq} {beacon | control | data | management |
probe}
channel {eq | neq} channel
bssid {eq | neq} bssid
```

```
src-mac {eq | neq | lt | gt} mac-addr
dest-mac {eq | neq | lt | gt} mac-addr
host-mac {eq | neq | lt | gt} mac-addr
mac-pair mac-addr1 mac-addr2
direction {eq | neq} {transmit | receive}
```

To match on packets to or from a specific MAC address, use the **dest-mac** or **src-mac** option. To match on both send and receive traffic for a host address, use the **host-mac** option. To match on a traffic flow (source and destination MAC addresses), use the **mac-pair** option. This option matches for either direction of a flow, and either MAC address can be the source or destination address.

If you omit a condition, all packets match that condition. For example, if you omit **frame-type**, all frame types match the filter.

For most conditions, you can use **eq** (equal) to match only on traffic that matches the condition value. Use **neq** (not equal) to match only on traffic that is not equal to the condition value. The **src-mac**, **dest-mac**, and **host-mac** conditions also support **lt** (less than) and **gt** (greater than).

The **observer** *ip-addr* option specifies the IP address of the station where the protocol analyzer is located. If you do not specify an observer, the MAP radio still counts the packets that match the filter. (See "Displaying Remote Traffic Monitoring Statistics" on page 643.)

The **snap-length** *num* option specifies the maximum number of bytes to capture. If you do not specify a length, the entire packet is copied and sent to the observer. 3Com recommends specifying a snap length of 100 bytes or less.

The following command configures a snoop filter named *snoop1* that matches on all traffic, and copies the traffic to the device that has IP address 10.10.30.2:

```
WX1200# set snoop snoop1 observer 10.10.30.2 snap-length 100
```

The following command configures a snoop filter named *snoop2* that matches on all data traffic between the device with MAC address aa:bb:cc:dd:ee:ff and the device with MAC address 11:22:33:44:55:66, and copies the traffic to the device that has IP address 10.10.30.3:

```
WX#1200 set snoop snoop2 frame-type eq data mac-pair
aa:bb:cc:dd:ee:ff 11:22:33:44:55:66 observer 10.10.30.3
snap-length 100
```

Displaying Configured Snoop Filters

To display the snoop filters configured on the WX switch, use the following command:

```
display snoop info [filter-name]
```

The following command shows the snoop filters configured in the examples above:

```
WX1200# display snoop info
snoop1:
        observer 10.10.30.2 snap-length 100
        all packets
snoop2:
        observer 10.10.30.3 snap-length 100
        frame-type eq data
        mac-pair (aa:bb:cc:dd:ee:ff, 11:22:33:44:55:66)
```

Editing a Snoop Filter

To edit a snoop filter, you can use the **display configuration area snoop** command to display the filter's configuration command, then use cut-and-paste to reconstruct the command.

Deleting a Snoop Filter

To delete a snoop filter, use the following command:

```
clear snoop filter-name
```

Mapping a Snoop Filter to a Radio

You can map a snoop filter to a radio on a MAP. To map a snoop filter to a radio, use the following command:

```
set snoop map filter-name ap apnumber radio {1 | 2}
```

You can map the same filter to more than one radio. You can map up to eight filters to the same radio. If more than one filter has the same observer, the MAP sends only one copy of a packet that matches a filter to the observer. After the first match, the MAP sends the packet and stops comparing the packet against other filters for the same observer.

If the filter does not have an observer, the MAP still maintains a counter of the number of packets that match the filter. (See "Displaying Remote Traffic Monitoring Statistics" on page 643.)

The following command maps snoop filter *snoop1* to radio 2 on MAP 3:

```
WX1200# set snoop map snoop1 ap 3 radio 2
success: change accepted.
```

Displaying the Snoop Filters Mapped to a Radio

To display the snoop filters that are mapped to a radio, use the following command:

```
display snoop map filter-name
```

The following command shows the mapping for snoop filter *snoop1*:

```
WX1200# display snoop map snoop1
filter 'snoop1' mapping
        Dap: 3          Radio: 2
```

Displaying the Snoop Filter Mappings for All Radios

To display all snoop filter mappings, use the following command:

```
WX1200# display snoop
Dap: 3          Radio: 2
        snoop1
        snoop2
Dap: 2          Radio: 2
        snoop2
```

Removing Snoop Filter Mappings

To remove a snoop filter from a specific radio, use the following command:

```
clear snoop map filter-name ap apnumber radio {1 | 2}
```

The following command removes snoop filter *snoop2* from radio 2 on MAP 3:

```
WX1200# clear snoop map snoop2 ap 3 radio 2
success: change accepted.
```

To remove all snoop filter mappings from all radios, use the following command:

```
clear snoop map all
```

Enabling or Disabling a Snoop Filter

A snoop filter does not take effect until you enable it. To enable or disable a snoop filter, use the following command:

```
set snoop {filter-name | all}
mode {enable | disable}
```

The filter operates until you manually disable it.

The filter mode is retained even if you disable and reenable the radio, or restart the MAP or the WX switch. Once the filter is enabled, you must use the ***disable*** *option to disable it.*

The following command enables snoop filter *snoop1:*

```
WX# set snoop snoop1 mode enable
success: filter 'snoop1' enabled
```

Displaying Remote Traffic Monitoring Statistics

The MAP collects statistics for packets that match the enabled snoop filters mapped to its radios. The MAP retains statistics for a snoop filter until the filter is changed or disabled. The MAP then clears the statistics.

To display statistics for packets matching a snoop filter, use the following command:

```
display snoop stats [filter-name [apnumber [radio {1 | 2}]]]
```

The following command shows statistics for snoop filter *snoop1*:

```
WX# display snoop stats snoop1
Filter          Ap Radio   Rx Match      Tx Match      Dropped
==============================================================
snoop1           3      1         96             4            0
```

Preparing an Observer and Capturing Traffic

To observe monitored traffic, install the following applications on the observer:

- Ethereal or Tethereal Version 0.10.8 or later
- Netcat (any version), if not already installed

Ethereal and Tethereal decode 802.11 packets embedded in TZSP without any configuration.

Use Netcat to listen to UDP packets on the TZSP port. This avoids a constant flow of ICMP destination unreachable messages from the observer back to the radio. You can obtain Netcat through the following link:

http://www.vulnwatch.org/netcat/

If the observer is a PC, you can use a Tcl script instead of Netcat if preferred.

1. Install the required software on the observer.
2. Configure and map snoop filters in MSS.
3. Start Netcat:
   - On Windows, use the following command:

   netcat -l -u -p 37008 -v -v

   Where *ip-addr* is the IP address of the Distributed MAP to which the snoop filter is mapped. (To display the Distributed MAP's IP address, use the **display ap status** command.)
4. Start the capture application:
   - For Ethereal capture, use **ethereal filter port 37008**.
   - For Tethereal capture, use **tethereal -V port 37008**.
5. Disable the option to decrypt 802.11 payloads. Because the MAP always decrypts the data before sending it to the observer, the observer does not need to perform any decryption. In fact, if you leave decryption enabled on the observer, the payload data becomes unreadable.

   To disable the decryption option in Ethereal:

   a. In the decode window, right-click on the *IEEE 802.11* line.
   b. Select **Protocol Preferences** to display the 802.11 Protocol Preferences dialog.
   c. Click next to **Ignore the WEP bit** to deselect the option. This option is applicable for any type of data encryption used by MAP radios.
   d. Enable the snoop filter on the MAP, using the following command:

   ```
   set snoop {filter-name | all} mode {enable | disable}
   ```

   e. Stop the Ethereal capture and view the monitored packets.

   The source IP address of a monitored packet identifies the Distributed MAP that copied the packet's payload and sent it to the observer.

Capturing System Information and Sending it to Technical Support

If you need help from 3Com Technical Support to diagnose a system problem, you can make troubleshooting the problem easier by providing the following:

- **display tech-support** output
- Core files
- Debug messages
- Description of the symptoms and network conditions when the problem occurred

The following sections show how to gather system information and send it to TAC.

The display tech-support Command

The **display tech-support** command combines a group of **display** commands to provide an in-depth snapshot of the status of the WX switch. The output displays details about the system image and configuration used after the last reboot, the version, ports, AAA settings, and other configuration values, and the last 100 log messages.

To save the output in a file to send to 3Com, use the following syntax:

`display tech-support` `[`**`file`** `[`*`subdirname`***`/`**`]`*`filename`*`]`

The following command saves the output in a file named *fortechsupport* and copies the file to a TFTP server.

```
WX1200# display tech-support file fortechsupport
success: results saved to fortechsupport.gz
WX1200# copy fortechsupport.gz tftp://192.168.0.233/fortechsupport.gz
success: sent 8259 bytes in 0.246 seconds [ 33573 bytes/sec]

success: copy complete.
```

Core Files

If a WX switch restarts due to an error condition (crashes), the switch generates a core file in the temporary file area. The name of the file indicates the system area where the problem occurred. Core files are saved in tarball (*tar*) format.

Core files are erased when you restart the switch. You must copy the files to a TFTP server or to the nonvolatile part of file storage before restarting the switch.

To copy core files, use the **dir** command to list them, then use the **copy** command to copy them. The following example shows how to list the files and copy them to a TFTP server.

```
WX1200# dir
===============================================================================
file:
Filename                                         Size           Created
file:configuration                               48 KB      Jul 12 2005, 15:02:32
file:sysa_bak                                    12 KB      Mar 15 2005, 19:18:44
Total:         60 Kbytes used, 207762 Kbytes free
===============================================================================
Boot:
Filename                                         Size           Created
boot0:WXA30001.Rel                             9780 KB      Aug 23 2005, 15:54:08
*boot1:WXA40101.Rel                            9796 KB      Aug 28 2005, 21:09:56
Boot0: Total:        9780 Kbytes used, 2460 Kbytes free
Boot1: Total:        9796 Kbytes used, 2464 Kbytes free
===============================================================================
temporary files:
Filename                                         Size           Created
core:command_audit.cur                          37 bytes   Aug 28 2005, 21:11:41
core:netsys.core.217.tar                         560 KB    May 06 2005, 21:48:33
Total:          560 Kbytes used, 91147 Kbytes free
```

In this example, the core file is netsys.core.217.tar. (The command_audit.cur file is not a core file and is created as part of normal system operation.)

The following command copies the core file onto a TFTP server.

```
WX1200# copy core:netsys.core.217.tar tftp://192.168.0.233/netsys.core.217.tar
...........success: sent 573440 bytes in 1.431 seconds [ 400726 bytes/sec]

success: copy complete.
```

If the switch’s network interfaces to the TFTP server have gone down, copy the core file to the nonvolatile file area before restarting the switch. The following commands copy netsys.core.217.tar to the nonvolatile file area and verify the result:

```
WX4400# copy core:netsys.core.217.tar file:netsys.core.217.tar
success: copy complete.
WX4400# dir
================================================================================
file:
Filename                                        Size           Created

core:netsys.core.217.tar                        560 KB    May 06 2005, 21:48:33
file:configuration                              48 KB     Jul 12 2005, 15:02:32
file:sysa_bak                                   12 KB     Mar 15 2005, 19:18:44
Total:         620 Kbytes used, 207202 Kbytes free
================================================================================
Boot:
Filename                                        Size           Created
boot0:wx040100.020                            9780 KB      Aug 23 2005, 15:54:08
*boot1:wx040100.020                           9796 KB      Aug 28 2005, 21:09:56
Boot0: Total:        9780 Kbytes used, 2460 Kbytes free
Boot1: Total:        9796 Kbytes used, 2464 Kbytes free
================================================================================
temporary files:
Filename                                        Size           Created
core:command_audit.cur                         37 bytes   Aug 28 2005, 21:11:41
core:netsys.core.217.tar                        560 KB    May 06 2005, 21:48:33
Total:          560 Kbytes used, 91147 Kbytes free
```

Debug Messages

In addition to generating a core file, the switch also sends debug messages to the serial console during a system crash. To capture the messages, attach a PC to the port (if one is not already attached) and use the terminal emulation application on the PC to capture a log of the messages. (For information about connecting to the serial console port, see the *Wireless LAN Switch and Controller Hardware Installation Guide*).

Sending Information to 3Com Technical Support

After you save the **display tech-support** output, as well as core files and debug messages (if applicable), you can send them to 3Com.

3Com has an external FTP server for use by customers to upload MSS debugging information, 3Com Wireless Switch Manager plans, and core dumps relating to active cases in 3Com Technical Support.

Additionally, 3Com Technical Support uses this FTP server as a place for customers to download private images and other case-related information from 3Com.

See "Obtaining Support for Your 3Com Products" on page 667 for more information.

B ENABLING AND LOGGING INTO WEB VIEW

Web View is a web-based management application available on WX switches. You can use Web View for common configuration and management tasks. On most WX models (WX-2200, WX-4400, or WXR100), you also can use Web View to perform initial configuration of a new switch.

System Requirements

Browser Requirements

Web View is supported on the following browsers:

- Mozilla Firefox Version 1.0 or later
- Microsoft Internet Explorer Version 6.0 or later

TLS 1.0, SSL 2.0, or SSL 3.0 must be enabled in the browser. To enable TLS 1.0, SSL 2.0, or SSL 3.0 in Microsoft Internet Explorer:

1. Select **Tools > Internet Options** to display the Internet Options dialog box.
2. Select the **Advanced** tab.
3. Scroll to the bottom of the list of options and select the TLS 1.0, SSL 2.0, or SSL 3.0 option to enable it.
4. Click **OK**.

WX Switch Requirements

- The WX switch's HTTPS server must be enabled. (This option is enabled by default.) If HTTPS is disabled, you can enable it using the following command:

```
set ip https server enable
```

- The switch must have an IP interface that can be reached by the PC where the browser is installed.

If you are configuring a new WX-2200, WX-4400, or WXR100, you can access Web View without any preconfiguration. Attach your PC directly to a WX-2200 switch's Ethernet management port or to any 10/100 Ethernet port on a WXR100. Then enter http://192.168.100.1 in the web browser's Location or Address field.

Logging Into Web View

1. Type **https://***ip-addr* in the Web browser's Address or Location field and press Enter.

   For *ip-addr*, type an IP address you configured on the switch.

2. If your browser displays a certificate warning, select an option to accept the certificate.

   The certificate is presented to your browser by the WX switch to authenticate the switch's identify. You can select to accept the certificate for the current web management session or for all web management sessions.

   After you accept the certificate, the browser might display another dialog asking whether you want to view the certificate. You can view the certificate or continue without viewing it.

3. In the User Name field, type **admin**.
4. In the Password field, type the enable password configured on the switch.
5. Click **OK**.

If your web browser has the Google toolbar installed, one of the toolbar's options can cause some of the fields in Web View to be highlighted in yellow. If you want to turn off the yellow highlighting, disable the Automatically highlight fields that Autofill can fill option, which is one of the toolbar's options.

C SUPPORTED RADIUS ATTRIBUTES

3Com Mobility System Software (MSS) supports the standard and extended RADIUS authentication and accounting attributes listed in Table 55 on page 652. Also supported are 3Com vendor-specific attributes (VSAs), listed in Table 56 on page 659.

Attributes

An attribute is sent to RADIUS accounting only if the table listing it shows *Yes* or *Optional* in the column marked *Sent in Accounting-Request* for the attribute *and* the attribute is applied to the client's session configuration. Attribute values have the following characteristics unless otherwise stated:

- Strings can contain a maximum of 253 characters.
- Integers are 4 bytes.
- IP addresses are 4 bytes.

The RADIUS attributes MSS supports are based on these IETF RFCs and drafts:

- RFC 2865, *Remote Authentication Dial-in User Service (RADIUS)*
- RFC 2866, *RADIUS Accounting*
- RFC 2868, *RADIUS Attributes for Tunnel Protocol Support*
- RFC 2869, *RADIUS Extensions*
- *draft-congdon-radius-8021x-29.txt* (*IEEE 802.1X RADIUS Usage Guidelines*)

Supported Standard and Extended Attributes

The RADIUS attributes shown in Table 55 are sent by WX switches to RADIUS servers during authentication and accounting.

Table 55 801.1X Attributes

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
User-Name	1	No	Yes	Yes	String. Name of the user to be authenticated. Used only in Request packets.
User-Password	2	No	Yes	No	Password of the user to be authenticated, unless a CHAP-Password is used.
CHAP-Password	3	No	Yes	No	Password of the user to be authenticated, unless a User-Password is used.
NAS-IP-Address	4	No	Yes	Yes	IP address sent by the WX switch.

Table 55 801.1X Attributes (continued)

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
Service-Type	5	No	Yes	Yes	Access type, which can be one of the following: 2—Framed; for network user access 6—Administrative; for administrative access to the WX switch, with authorization to access the enabled (configuration) mode. The user must enter the **enable** command to access the enabled mode. 7—NAS-Prompt; for administrative access to the nonenabled mode only. In this mode, the **enable** command is not available and the user cannot log in to the enabled mode. For administrative sessions, the WX switch will send 7 (NAS-Prompt) unless the service-type attribute has been configured for the user. The RADIUS server can reply with one of the values listed above. If the service-type is not set on the RADIUS server, administrative users receive NAS-Prompt access, and network users receive Framed access. **Note:** MSS will quietly accept Callback Framed, but you cannot select this access type in MSS.

Table 55 801.1X Attributes (continued)

Attribute	**Type**	**Rcv in Access Resp?**	**Sent in Access Reqst?**	**Sent in Acct Reqst?**	**Description**
Filter-Id	11	Yes	No	Optional	If configured in the WX switch's local database, this attribute can be an access control list (ACL) to filter outbound or inbound traffic. Use the following format: **filter-id** *inboundacl*.**in** or **filter-id** *outboundacl*.**out** If you are configuring the attribute on a RADIUS server, the value field of filter-id can specify up to two ACLs. Any of the following are valid: filter-id = "Profile=acl1" filter-id = "OutboundACL=acl2" filter-id = "Profile=acl1 OutboundACL=acl2" (Each example goes on a single line on the server.) The format in which to specify the values depends on the RADIUS server. Regardless of whether the attributes are defined locally or on a RADIUS server, the ACLs must already be configured on the WX switch. (For details, see Chapter 19, "Configuring and Managing Security ACLs," on page 377.)

Table 55 801.1X Attributes (continued)

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
Reply-Message	18	Yes	No	No	String. Text that can be displayed to the user. Multiple Reply-Messages can be included. If any are displayed, they must appear in the order in which they appear in the packet.
State	24	Yes	Yes	No	Can be sent by a RADIUS server in an Access-Challenge message to the WX switch. If the WX receives an Access-Challenge with this attribute, it returns the same State value in an Access-Request response to the RADIUS server, when a response is required. (For details, see RFC 2865.)
Class	25	Yes	No	Yes	If received, this information must be sent on, without interpretation, in all subsequent packets sent to the RADIUS server for that client session.
Vendor-Specific	26	Yes	No	Yes	String. Allows MSS to support 3Com VSAs. (See Table 56 on page 659.)
Session-Timeout	27	Yes	No	Optional	Maximum number of seconds of service allowed the user before reauthentication of the session. If the global reauthentication timeout (set by the **set dot1x reauth-period** command) is shorter than the session-timeout, MSS uses the global timeout instead.

Table 55 801.1X Attributes (continued)

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
Called-Station-Id	30	No	Yes	Yes	For IEEE 802.1X authenticators, stores the MAP MAC address in uppercase ASCII format, with octet values separated by hyphens (for example, 00-10-A4-23-19-C0).
Calling-Station-Id	31	No	Yes	Yes	For IEEE 802.1X authenticators, stores the supplicant MAC address in uppercase ASCII format, with octet values separated by hyphens (for example, 00-10-A4-23-19-C0).
NAS-Identifier	32	No	Yes	No	Name of the RADIUS client originating an Access-Request. The value in the current release is *3Com* and cannot be changed.
Acct-Status-Type	40	No	No	Yes	Valid values: ▪ Acct-Start ▪ Acct-Interim-Update ▪ Acct-Stop
Acct-Delay-Time	41	No	No	Yes	Time in seconds for which the client has been trying to send the record.
Acct-Input-Octets	42	No	No	Yes	Number of octets received from the port over the course of this service being provided. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update.

Table 55 801.1X Attributes (continued)

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
Acct-Output-Octets	43	No	No	Yes	Number of octets sent on the port in the course of this service being provided. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update.
Acct-Session-Id	44	No	No	Yes	Unique accounting ID to facilitate matching start and stop records in a log file. The start and stop records for a given session must have the same Acct-Session-Id.
Acct-Authentic	45	No	No	Yes	Valid values: ▪ RADIUS ▪ Local
Acct-Session-Time	46	No	No	Yes	Number of seconds for which the user has received service. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update.
Acct-Input-Packets	47	No	No	Yes	Number of packets received in the course of this service being provided. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update.

Table 55 801.1X Attributes (continued)

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
Acct-Output-Packets	48	No	No	Yes	Number of packets sent in the course of this service being provided. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update.
Acct-Multi-Session-Id	50	No	No	Yes	Unique accounting ID that facilitates linking together multiple related sessions in a log file. Each linked session has a unique Acct-Session-Id but the same Acct-Multi-Session-Id.
Acct-Input-Gigawords	52	No	No	Yes	Number of times the Acct-Input-Octets counter has wrapped around 2^{32} over the course of this service being provided. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update. (For details, see RFC 2869.)
Acct-Output-Gigawords	53	No	No	Yes	Number of times the Acct-Output-Octets counter has wrapped around 2^{32} over the course of this service being provided. Can be present only in Accounting-Request records in which Acct-Status-Type is set to Acct-Stop or Acct-Interim-Update. (For details, see RFC 2869.)

Table 55 801.1X Attributes (continued)

Attribute	Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
Event-Timestamp	55	No	No	Yes	Time that the user session started, stopped, or was updated, in seconds since January 1, 1970.
Tunnel-Private-Group-ID	81	Yes	No	No	Same as VLAN-Name.
NAS-Port-Id	87	No	Yes	Yes	WX physical port that authenticates the user, in the form *MAP port number/radio*.

3Com Vendor-Specific Attributes

The vendor-specific attributes (VSAs) created by 3Com are embedded according to the procedure recommended in RFC 2865, with Vendor-ID set to 43. Table 56 describes the 3Com VSAs, listed in order by vendor type number.

(For attribute details, see Table 43, "Authentication Attributes for Local Users," on page 488.)

Table 56 3Com VSAs

Attribute	Type, Vendor ID, Vendor Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
VLAN-Name	26, 43, 2	Yes	No	Yes	Name of the VLAN to which the client belongs.
Mobility-Profile	26, 43, 3	Yes	No	No	Name of the Mobility Profile used by the authorized client.
Encryption-Type	26, 43, 4	Yes	No	No	Type of encryption used to authenticate the client.
Time-Of-Day	26, 43, 5	Yes	No	No	Day(s) and time(s) during which a user can log into the network.

Table 56 3Com VSAs (continued)

Attribute	Type, Vendor ID, Vendor Type	Rcv in Access Resp?	Sent in Access Reqst?	Sent in Acct Reqst?	Description
SSID	26, 43, 6	Yes	No	Yes	Name of the SSID you want the user to use. The SSID must be configured in a service profile, and the service profile must be used by a radio profile assigned to 3Com radios in the Mobility Domain.
End-Date	26, 43, 7	Yes	No	No	Date and time after which the user is no longer allowed to be on the network. Use the following format: YY/MM/DD-HH:MM
Start-Date	26, 43, 7	Yes	No	No	Date and time at which the user becomes eligible to access the network. Use the following format: YY/MM/DD-HH:MM
URL	26, 43, 8	Yes	No	No	URL to which the user is redirected after successful WebAAA. Use the following format: http://www.example.com

D TRAFFIC PORTS USED BY MSS

When deploying a 3Com wireless network, you might attach 3Com equipment to subnets that have firewalls or access controls between them. 3Com equipment uses various protocol ports to exchange information. To ensure full operation of your network, make sure the equipment can exchange information on the ports listed in Table 57.

Table 57 Traffic Ports Used by MSS

Protocol	Port	Function
IP/TCP (6)	23	Telnet management
IP/TCP (6)	443	SSL management of a WX via Web View Port 443 is also the default port used by 3Com Wireless Switch Manager clients to communicate with a 3Com Wireless Switch Manager server.
IP/TCP (6)	8821	Network Domain and Mobility Domain management The originating WX makes a connection from a random TCP port that is equal to or higher than 4096. The target WX listens for the traffic on TCP port 8821.
IP/TCP (6)	8889	SSL management via 3WXM or Guest Access Manager 3WXM or Guest Access Manager originates the SSL connection on TCP port 8889.
IP/UDP (17)	53	DNS
IP/UDP (17)	123	NTP
IP/UDP (17)	161	SNMP get and set operations
IP/UDP (17)	162	SNMP traps
IP/UDP (17)	1812	RADIUS authentication (default setting)
IP/UDP (17)	1813	RADIUS accounting (default setting)

Table 57 Traffic Ports Used by MSS (continued)

Protocol	Port	Function
IP/UDP (17)	5000	WX-MAP communication. This applies to WX communication with Distributed MAPs and with directly connected MAPs.
IP/ICMP (1)	N/A	Several types (for example, ping)

Roaming traffic uses IP tunnels, encapsulated with IP protocol 4.

To list the TCP port numbers in use on a WX, including those for the other end of a connection, use the **display tcp** command.

E DHCP SERVER

MSS has a DHCP server that the switch uses to allocate IP addresses to the following:

- Directly connected MAPs
- Host connected to a new (unconfigured) WXR100, to configure the switch using the Web Quick Start

DHCP service for these items is enabled by default.

Optionally, you can configure the DHCP server to also provide IP addresses to Distributed MAPs and to clients.

Configuration is supported on an individual VLAN basis. When you configure the DHCP server on a VLAN, the server can serve addresses only from the subnet that contains the host address assigned to the VLAN. By default, the VLAN can serve any unused address in the subnet except the VLAN's host address and the network and broadcast addresses. You can specify the address range.

You can configure the DHCP server on more than one VLAN. You can configure a DHCP client and DHCP server on the same VLAN, but only the client or the server can be enabled. The DHCP client and DHCP server cannot both be enabled on the same VLAN at the same time.

The MSS DHCP server is implemented according to "RFC 2131: Dynamic Host Configuration Protocol" and "RFC 2132: DHCP Options and BOOTP Vendor Extensions", with the following exceptions:

- If the switch is powered down or restarted, MSS does not retain address allocations or lease times.
- The MSS DHCP server will not operate properly when another DHCP server is present on the same subnet.

- The MSS DHCP server is configurable on an individual VLAN basis only, and operates only on the subnets for which you configure it.

Use of the MSS DHCP server to allocate client addresses is intended for temporary, demonstration deployments and not for production networks. 3Com recommends that you do not use the MSS DHCP server to allocate client addresses in a production network.

How the MSS DHCP Server Works

When MSS receives a DHCP Discover packet, the DHCP server allocates an address from the configured range according to RFC 2131 and ARPs the address to ensure that it is not already in use. If the address is in use, the server allocates the next address in the range, and ARPs again. The process continues until MSS finds an address that is not in use. MSS then offers the address to the Distributed MAP or client that sent the DHCP Discover. If there are no unused addresses left in the range, MSS ignores the DHCP Discover and generates a log message.

If the client does not respond to the DHCP Offer from the MSS DHCP server within 2 minutes, the offer becomes invalid and MSS returns the address to the pool.

The siaddr value in the DHCP exchanges is the IP address of the VLAN. The yiaddr value is an unused address within the range the server is allowed to use.

In addition to an IP address, the Offer message from the MSS DHCP server also contains the following options:

- Option 54—Server Identifier, which has the same value as siaddr.
- Option 51—Address Lease, which is 12 hours and cannot be configured.
- Option 1—Subnet Mask of the VLAN’s IP interface.
- Option 15—Domain Name. If this option is not set with the **set interface dhcp-server** command’s **dns-domain** option, the MSS DHCP server uses the value set by the **set ip dns domain** command.

- Option 3—Default Router. If this option is not set with the **set interface dhcp-server** command's **default-router** option, the MSS DHCP server can use the value set by the **set ip route** command. A default route configured by **set ip route** can be used if the route is in the DHCP client's subnet. Otherwise, the MSS DHCP server does not specify a router address.
- Option 6—Domain Name Servers. If these options are not set with the **set interface dhcp-server** command's **primary-dns** and **secondary-dns** options, the MSS DHCP server uses the values set by the **set ip dns server** command.

Configuring the DHCP Server

You can configure the DHCP server on an individual VLAN basis. To configure the server, use the following command:

```
set interface vlan-id ip dhcp-server [enable | disable] [start
ip-addr1
stop ip-addr2] [dns-domain domain-name] [primary-dns ip-addr
[secondary-dns ip-addr]] [default-router ip-addr]
```

The *vlan-id* can be the VLAN name or number.

The **start** *ip-addr1* and **stop** *ip-addr2* options specify the beginning and ending addresses of the address range (also called the address *pool*). By default, all addresses except the host address of the VLAN, the network broadcast address, and the subnet broadcast address are included in the range. If you specify the range, the start address must be lower than the stop address, and all addresses must be in the same subnet. The IP interface of the VLAN must be within the same subnet but is not required to be within the range.

The following command enables the DHCP server on VLAN *red-vlan* to serve addresses from the 192.168.1.5 to 192.168.1.25 range:

```
WX1200# set interface red-vlan ip dhcp-server enable start
192.168.1.5 stop 192.168.1.25
success: change accepted.
```

To remove all IP information from a VLAN, including the DHCP client and user-configured DHCP server, use the following command:

```
clear interface vlan-id ip
```

This command clears all IP configuration information from the interface.

Displaying DHCP Server Information

To display information about the MSS DHCP server, use the following command:

```
display dhcp-server [interface vlan-id] [verbose]
```

If you enter the command without the interface or verbose option, the command displays a table of all the IP addresses leased by the server. You can use the **interface** option to display addresses leased by a specific VLAN.

If you use the **verbose** option, configuration and status information is displayed instead.

The following command displays the addresses leased by the DHCP server:

```
WX1200# display dhcp-server
VLAN Name           Address         MAC               Lease Remaining (sec)
---- -------------- --------------- ----------------- --------------------
   1 default        10.10.20.2      00:01:02:03:04:05                12345
   1 default        10.10.20.3      00:01:03:04:06:07                 2103
   2 red-vlan       192.168.1.5     00:01:03:04:06:08                  102
   2 red-vlan       192.168.1.7     00:01:03:04:06:09                16789
```

The following command displays configuration and status information for each VLAN on which the DHCP server is configured:

```
WX1200# display dhcp-server verbose
Interface:        0 (Direct AP)
 Status:           UP
 Address Range:    10.0.0.1-10.0.0.253

 Interface:            default(1)
 Status:               UP
 Address Range:        10.10.20.2-10.10.20.254
Hardware Address:     00:01:02:03:04:05
   State:               BOUND
   Lease Allocation:    43200 seconds
   Lease Remaining:     12345 seconds
   IP Address:          10.10.20.2
   Subnet Mask:         255.255.255.0
      DNS Servers:         10.10.20.4 10.10.20.5
   DNS Domain Name:     mycorp.com
```

In addition to information for addresses leased from the VLANs where you configured the server, information for the Direct AP interface is also displayed. The Direct AP interface is an internal VLAN interface for directly connected MAPs.

F

OBTAINING SUPPORT FOR YOUR 3COM PRODUCTS

3Com offers product registration, case management, and repair services through eSupport.3com.com. You must have a user name and password to access these services, which are described in this appendix.

Register Your Product to Gain Service Benefits

To take advantage of warranty and other service benefits, you must first register your product at:

http://eSupport.3com.com/

3Com eSupport services are based on accounts that are created or that you are authorized to access.

Solve Problems Online

3Com offers the following support tool:

- **3Com Knowledgebase —** Helps you to troubleshoot 3Com products. This query-based interactive tool is located at:

  http://knowledgebase.3com.com

  It contains thousands of technical solutions written by 3Com support engineers.

Purchase Extended Warranty and Professional Services

To enhance response times or extend your warranty benefits, you can purchase value-added services such as 24x7 telephone technical support, software upgrades, onsite assistance, or advanced hardware replacement.

Experienced engineers are available to manage your installation with minimal disruption to your network. Expert assessment and implementation services are offered to fill resource gaps and ensure the success of your networking projects. For more information on 3Com Extended Warranty and Professional Services, see:

http://www.3com.com/

Contact your authorized 3Com reseller or 3Com for additional product and support information. See the table of access numbers later in this appendix.

Access Software Downloads

You are entitled to *bug fix / maintenance releases* for the version of software that you initially purchased with your 3Com product. To obtain access to this software, you need to register your product and then use the Serial Number as your login. Restricted Software is available at:

http://eSupport.3com.com/

To obtain software releases that *follow* the software version that you originally purchased, 3Com recommends that you buy an Express or Guardian contract, a Software Upgrades contract, or an equivalent support contract from 3Com or your reseller. Support contracts that include software upgrades cover feature enhancements, incremental functionality, and bug fixes, but they do not include software that is released by 3Com as a separately ordered product. Separately orderable software releases and licenses are listed in the 3Com Price List and are available for purchase from your 3Com reseller.

Contact Us

3Com offers telephone, internet, and e-mail access to technical support and repair services. To access these services for your region, use the appropriate telephone number, URL, or e-mail address from the table in the next section.

Telephone Technical Support and Repair

To obtain telephone support as part of your warranty and other service benefits, you must first register your product at:

http://eSupport.3com.com/

When you contact 3Com for assistance, please have the following information ready:

- Product model name, part number, and serial number
- A list of system hardware and software, including revision level
- Diagnostic error messages
- Details about recent configuration changes, if applicable

To send a product directly to 3Com for repair, you must first obtain a return materials authorization number (RMA). Products sent to 3Com without authorization numbers clearly marked on the outside of the package will be returned to the sender unopened, at the sender's expense. If your product is registered and under warranty, you can obtain an RMA number online at http://eSupport.3com.com/. First-time users must apply for a user name and password.

Telephone numbers are correct at the time of publication. Find a current directory of 3Com resources by region at: http://csoweb4.3com.com/contactus/

Country	Telephone Number	Country	Telephone Number
Asia, Pacific Rim — Telephone Technical Support and Repair			
Australia	1800 075 316	Philippines	1800 144 10220 or 029003078
Hong Kong	2907 0456		
India	000 800 440 1193	PR of China	800 810 0504
Indonesia	001 803 852 9825	Singapore	800 616 1463
Japan	03 3507 5984	South. Korea	080 698 0880
Malaysia	1800 812 612	Taiwan	00801 444 318
New Zealand	0800 450 454	Thailand	001 800 441 2152

Pakistan Call the U.S. direct by dialing 00 800 01001, then dialing 800 763 6780
Sri Lanka Call the U.S. direct by dialing 02 430 430, then dialing 800 763 6780
Vietnam Call the U.S. direct by dialing 1 201 0288, then dialing 800 763 6780

You can also obtain non-urgent support in this region at this email address apr_technical_support@3com.com
Or request a return material authorization number (RMA) by FAX using this number: +61 2 9937 5048, or send an email at this email address: ap_rma_request@3com.com

Europe, Middle East, and Africa — Telephone Technical Support and Repair

From anywhere in these regions not listed below, call: +44 1442 435529

Country	Telephone Number	Country	Telephone Number
From the following countries, call the appropriate number:			
Austria	0800 297 468	Luxembourg	800 23625
Belgium	0800 71429	Netherlands	0800 0227788
Denmark	800 17309	Norway	800 11376
Finland	0800 113153	Poland	00800 4411 357
France	0800 917959	Portugal	800 831416
Germany	0800 182 1502	South Africa	0800 995 014
Hungary	06800 12813	Spain	900 938 919
Ireland	1 800 553 117	Sweden	020 795 482
Israel	180 945 3794	Switzerland	0800 553 072
Italy	800 879489	U.K.	0800 096 3266

You can also obtain support in this region using this URL: http://emea.3com.com/support/email.html

You can also obtain non-urgent support in this region at these email addresses:
Technical support and general requests: customer_support@3com.com
Return material authorization: warranty_repair@3com.com
Contract requests: emea_contract@3com.com

Latin America — Telephone Technical Support and Repair

Antigua	1 800 988 2112	Guatemala	AT&T +800 998 2112
Argentina	0 810 444 3COM	Haiti	57 1 657 0888
Aruba	1 800 998 2112	Honduras	AT&T +800 998 2112
Bahamas	1 800 998 2112	Jamaica	1 800 998 2112
Barbados	1 800 998 2112	Martinique	571 657 0888
Belize	52 5 201 0010	Mexico	01 800 849CARE
Bermuda	1 800 998 2112	Nicaragua	AT&T +800 998 2112
Bonaire	1 800 998 2112	Panama	AT&T +800 998 2112
Brazil	0800 13 3COM	Paraguay	54 11 4894 1888
Cayman	1 800 998 2112	Peru	AT&T +800 998 2112
Chile	AT&T +800 998 2112	Puerto Rico	1 800 998 2112
Colombia	AT&T +800 998 2112	Salvador	AT&T +800 998 2112
Costa Rica	AT&T +800 998 2112	Trinidad and Tobago	1 800 998 2112
Curacao	1 800 998 2112	Uruguay	AT&T +800 998 2112
Ecuador	AT&T +800 998 2112	Venezuela	AT&T +800 998 2112
Dominican Republic	AT&T +800 998 2112	Virgin Islands	57 1 657 0888

You can also obtain support in this region in the following ways:

- Spanish speakers, enter the URL: http://lat.3com.com/lat/support/form.html
- Portuguese speakers, enter the URL: http://lat.3com.com/br/support/form.html
- English speakers in Latin America, send e-mail to: lat_support_anc@3com.com

US and Canada — Telephone Technical Support and Repair

All locations:	Network Jacks; Wired or Wireless Network Interface Cards:	1 847-262-0070
	All other 3Com products:	1 800 876 3266

GLOSSARY

3Com Wireless Switch Manager™ (3WXM)™	A tool suite for planning, configuring, deploying, and managing a 3Com Mobility System wireless LAN (WLAN). Based on site and user requirements, 3WXM determines the location of Wireless Switches (WXs) and Managed Access Points (MAPs) and can store and verify configuration information before installation. After installation, 3WXM deploys the settings on the equipment and manages and verifies configuration changes. To monitor network performance, 3WXM collects WX and MAP information, calculates and displays MAP neighbor relationships, and detects anomalous events — for example, rogue access points.
3DES	A three-round application of the Data Encryption Standard (DES) that uses a 168-bit encryption key. See also *DES*.
802.1D	The IEEE LAN specification for the operation of media access control (MAC) bridges.
802.1p	An IEEE LAN standard method for classifying packets in bridged virtual LANs (VLANs). As part of 802.1Q protocol, 802.1p defines a field in the VLAN tag of a frame header that provides class-of-service (CoS) definitions at Layer 2. See also *802.1Q*.
802.1Q	The IEEE LAN standard that defines a protocol for filtering and forwarding services at Layer 2. Ethernet frames are directed by means of a tag inserted into the frame header. A virtual LAN (VLAN) identifier (VID) field in the tag identifies the VLAN with which the frame is associated.
802.1X	The primary IEEE standard for port-based network access control. The 802.1X standard, which is based on the Extensible Authentication Protocol (EAP), provides an authentication framework that supports a variety of methods for authenticating and authorizing network access for wired or wireless users. See also *EAP*; *EAP-TLS*; *PEAP*; *TLS*; *TTLS*.

802.2	An IEEE LAN specification that defines the logical link control (LLC) sublayer, the upper portion of the Data Link layer. LLC encapsulation can be used by any lower-layer LAN technology. Compare *802.3*; *Ethernet II*.
802.3	An IEEE LAN specification for a Carrier Sense Multiple Access with Collision Detection (CSMA-CD) network, a type of network related to Ethernet. In general, 802.3 specifies the physical media and the working characteristics of LANs. An 802.3 frame uses source and destination media access control (MAC) addresses to identify its originator and receiver (or receivers). Compare *802.2*; *Ethernet II*.
802.3z	An extension to the IEEE 802.3 LAN specification, describing gigabit Ethernet (1000 Mbps) transmission. The extension includes specifications for the media access control (MAC), physical layer, repeater, and management characteristics of gigabit Ethernet.
802.11	An IEEE LAN specification that defines the mobile (wireless) network access link layer. The specification includes the 802.11 media access control (MAC) sublayer of the Data Link layer, and two sublayers of the Physical (PHY) layer — a frequency-hopping spread-spectrum (FHSS) physical layer and a direct-sequence spread-spectrum (DSSS) link layer. Later additions to 802.11 include additional physical layers. See also *802.11a*; *802.11b*; *802.11g*; *802.11i*.
802.11a	A supplement to the IEEE 802.11 wireless LAN (WLAN) specification, describing transmission through the Physical layer (PHY) based on orthogonal frequency division multiplexing (OFDM), at a frequency of 5 GHz and data rates of up to 54 Mbps.
802.11b	A supplement to the IEEE 802.11 wireless LAN (WLAN) specification, describing transmission through the Physical layer (PHY) based on direct-sequence spread-spectrum (DSSS), at a frequency of 2.4 GHz and data rates of up to 11 Mbps.
802.11b/g radio	A radio that can receive and transmit signals at IEEE 802.11b and 802.11g data rates. 3Com 802.11b/g radios allow associations from 802.11b clients as well as 802.11g clients by default, for networks that have a mixture of both client types. However, association by any 802.11b clients restricts the maximum data transmit rate for all clients. To allow the radios to operate at the higher 802.11g data rates, you can set 802.11b/g radios to reject association attempts by 802.11b clients.

802.11g	A supplement to the IEEE 802.11 wireless LAN (WLAN) specification, describing transmission through the Physical layer (PHY) based on orthogonal frequency division multiplexing (OFDM), at a frequency of 2.4 GHz and data rates of up to 54 Mbps.
802.11i	A draft supplement to the IEEE 802.11 wireless LAN (WLAN) specification, for enhanced security through the use of stronger encryption protocols such as the Temporal Key Integrity Protocol (TKIP) and AES Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP). These protocols provide replay protection, cryptographically keyed integrity checks, and key derivation based on the IEEE 802.1X port authentication standard. See also *AES*; *CCMP*; *TKIP*; *WPA*.
AAA	Authentication, authorization, and accounting. A framework for configuring services that provide a secure network connection and a record of user activity, by identifying who the user is, what the user can access, and what services and resources the user is consuming. In a 3Com Mobility System, the Wireless Switch (WX) can use a RADIUS server or its own local database for AAA services.
access control entry	See *ACE*.
access control list	See *security ACL*.
access point (AP)	A hardware unit that acts as a communication hub by linking wireless mobile IEEE 802.11 stations such as PCs to a wired backbone network. A 3Com Mobility System has Managed Access Points (MAPs). See also *ad hoc network*; *infrastructure network*; *Managed Access Point™ (MAP™)*.
ACE	A rule in a security access control list (ACL) that grants or denies a set of network access rights based on one or more criteria. ACEs use criteria such as a protocol and a source or destination IP address to determine whether to permit or deny packets that match the criteria. ACEs are processed in the order in which they appear in the security ACL. See also *security ACL*.
ACL	See *security ACL*.

ad hoc network	One of two IEEE 802.11 network frameworks. In an ad hoc network, a set of wireless stations communicate directly with one another without using an access point (AP) or any connection to a wired network. With an ad hoc network, also known as a *peer-to-peer network* or *independent basic service set (IBSS)*, you can set up a wireless network in which a wireless infrastructure does not exist or is not required for services (in a classroom, for example), or through which access to the wired network is prevented (for consultants at a client site, for example). Compare *infrastructure network*.
Advanced Encryption Standard	See *AES*.
AES	Advanced Encryption Standard. One of the Federal Information Processing Standards (FIPS). The AES, documented in FIPS Publication 197, specifies a symmetric encryption algorithm for use by organizations to protect sensitive information. See *802.11i*; *CCMP*.
AP	See *access point (AP)*.
association	The process defined in IEEE 802.11 by which an authenticated mobile (wireless) station establishes a relationship with a wireless access point (AP) to gain full network access. The access point assigns the mobile station an association identifier (AID), which the wireless LAN (WLAN) uses to track the mobile station as it roams. After associating with a Managed Access Point (MAP) in a 3Com Mobility System, a mobile station can send and receive traffic through any MAP within the same Mobility Domain™ group.
attribute	In authentication, authorization, and accounting (AAA), a property used to identify (authenticate) a user or to configure (authorize) or record (account for) a user's administrative or network session. A user's AAA attributes are stored in a user profile in the local database on a Wireless Switch (WX), or on a RADIUS server. Attribute names are case-sensitive. See also *RADIUS*; *VSA*.
authenticated identity	In a 3Com Mobility System, the correspondence established between a user and his or her authentication attributes. User authentication attributes are linked to the *user*, rather than to a physical port or device, regardless of the user's location or type of network connection. Because the authenticated identity follows the user, he or she requires no reauthentication when roaming.

authentication, authorization, and accounting	See *AAA*.
authentication mobility	The ability of a user (client) authenticated via Extensible Authentication Protocol (EAP) — plus an appropriate subprotocol and back-end authentication, authorization, and accounting (AAA) service — to roam to different access points (APs) without reauthentication.
authentication server	An entity that provides an authentication service to an authenticator. From the credentials provided by a client (or *supplicant*), the authentication service determines whether the supplicant is authorized to access the services of the authenticator. In a 3Com Mobility System, one or more RADIUS servers can act as authentication servers.
authenticator	A device that authenticates a client. In a 3Com Mobility System, the authenticator is a Wireless Switch (WX).
baseline association rate	A value set in 3Com Wireless Switch Manager (3WXM) to help plan Managed Access Point (MAP) coverage in a network. The baseline association rate is the average data transmission rate at which you want typical mobile clients in the coverage area to associate with the access point(s).
basic service set	See *BSS*.
basic service set identifier	See *BSSID*.
bias	The priority of one Wireless Switch (WX) over other WX switches for booting, configuring, and providing data transfer for a Managed Access Point (MAP). Bias can be set to either low or high on each WX switch and is high by default. Bias applies only to WX switches that are indirectly attached to the MAP through an intermediate Layer 2 or Layer 3 network. A MAP always attempts to boot on MAP port 1 first, and if the MAP is directly attached to a WX switch on MAP port 1, the MAP uses the directly attached WX switch to boot from regardless of the bias settings. See also *dual-homed connection*.
BSS	Basic service set. A set of wireless stations that communicate with one another through an access point (AP).

BSSID	Basic service set identifier. The 48-bit media access control (MAC) address of the radio in the access point (AP) that serves the stations in a basic service set (BSS).
CA	See *certificate authority (CA)*.
CBC-MAC	See *CCMP*.
CCI	Co-channel interference. Obstruction that occurs when one signal on a particular frequency intrudes into a cell that is using that same frequency for transmission. In multicell networks, systems are designed to minimize CCI through appropriate transmission power and channel selection.
CCMP	Counter-Mode with Cipher Block Chaining Message Authentication Code Protocol. A wireless encryption protocol based on the Advanced Encryption Standard (AES) and defined in the IEEE 802.11i specification. CCMP uses a symmetric key block cipher mode that provides privacy by means of counter mode and data origin authenticity by means of cipher block chaining message authentication code (CBC-MAC). See also *802.11i*; *AES*; *TKIP*; *WPA*. Compare *WEP*.
cell	The geographical area covered by a wireless transmitter.
certificate authority (CA)	Network software that issues and manages security credentials and public keys for authentication and message encryption. As part of a public-key infrastructure (PKI), which enables secure exchanges of information over a network, a certificate authority checks with a registration authority (RA) to verify information provided by the requestor of a digital certificate. If the registration authority verifies the requestor's information, the certificate authority can issue a certificate. Based on the PKI implementation, the certificate content can include the certificate's expiration date, the owner's public key, the owner's name, and other information about the public-key owner. See also *registration authority (RA)*.
Certificate Signing Request	See *CSR*.
Challenge Handshake Authentication Protocol	See *CHAP*.

CHAP	Challenge Handshake Authentication Protocol. An authentication protocol that defines a three-way handshake to authenticate a user (client). CHAP uses the MD5 hash algorithm to generate a response to a challenge that can be checked by the authenticator. For wireless connections, CHAP is not secure and must be protected by the cryptography in such authentication methods as the Protected Extensible Authentication Protocol (PEAP) and Tunneled Transport Layer Security (TTLS).
client	The requesting program or device in a client-server relationship. In a wireless LAN (WLAN), the client (or *supplicant*) requests access to the services provided by the authenticator. See also *supplicant*.
co-channel interference	See *CCI*.
collision domain	A single half-duplex IEEE 802.3 Carrier Sense Multiple Access with Collision Detection (CSMA-CD) network. A collision occurs when two or more Layer 2 devices in the network transmit at the same time. Ethernet segments separated by a Layer 2 switch are within different collision domains.
comma-separated values file	See *CSV file*.
communications plenum cable	See *plenum-rated cable*.
coverage area	In 3Com Wireless Switch Manager (3WXM), the smallest unit of floor space within which to plan access point coverage for a wireless LAN (WLAN). The number of access points required for a coverage area depends on the type of IEEE 802.11 transmission used, and the area's physical features and user density.
CPC	Communications plenum cable. See *plenum-rated cable*.
CRC	Cyclic redundancy check. A primitive message integrity check.
crypto	See *cryptography*.

cryptography	The science of information security. Modern cryptography is typically concerned with the processes of scrambling ordinary text (known as *plain text* or *clear text*) into encrypted text at the sender’s end of a connection, and decrypting the encrypted text back into clear text at the receiver’s end. Because its security is independent of the channels through which the text passes, cryptography is the only way of protecting communications over channels that are not under the user’s control. The goals of cryptography are *confidentiality*, *integrity*, *nonrepudiation*, and *authentication*. The encrypted information cannot be understood by anyone for whom it is not intended, or altered in storage or transmission without the alteration being detected. The sender cannot later deny the creation or transmission of the information, and the sender and receiver can confirm each other’s identity and the information’s origin and destination.
CSR	Certificate Signing Request. A message sent by an administrator to request a security certificate from a certificate authority (CA). A CSR is a text string formatted by Privacy-Enhanced Mail (PEM) protocol according to Public Key Cryptography Standard (PKCS) #10. The CSR contains the information needed by the certificate authority to generate the certificate.
CSV file	Comma-separated values file. A text file that displays tabular data in a comma-delimited format, as a list of rows in which each column’s value is separated from the next by a comma. A CSV file is useful for transferring data between database applications.
cyclic redundancy check	See *CRC*.
dBm	Decibels referred to 1 milliwatt (mW). A measurement of relative power related to 1 mW. For example, *20 dBm* corresponds to $10^{20\ \mathrm{dBm}/10} = 100\ \mathrm{mW}$.
decibels referred to 1 milliwatt (mW).	See *dBm*.
Data Encryption Standard	See *DES*.
delivery traffic indication map	See *DTIM*.

DES	Data Encryption Standard. A federally approved symmetric encryption algorithm in use for many years and replaced by the Advanced Encryption Standard (AES). See also *3DES*.
DHCP	Dynamic Host Configuration Protocol. A protocol that dynamically assigns IP addresses to stations, from a centralized server. DHCP is the successor to the Bootstrap Protocol (BOOTP).
dictionary attack	An attempt to gain illegal access to a computer or network by logging in repeatedly with passwords that are based on a list of terms in a dictionary.
Diffie-Hellman	A key exchange algorithm that was the first public-key algorithm ever published. Diffie-Hellman can be used anonymously (without authentication). Anonymous Diffie-Hellman is used to establish the connection between the 3Com Wireless Switch Manager (3WXM) and a Wireless Switch (WX).
Diffserv	Differentiated services. An architecture for providing different types or levels of service for network traffic. Diffserv aggregates flows in the network so that routers and switches need to distinguish only a relatively small number of aggregated flows, even if those flows contain thousands or millions of individual flows.
digital certificate	A document containing the name of a user (client) or server, a digital signature, a public key, and other elements used in authentication and encryption. See also *X.509*.
digital signature	The result of encrypting a hash of a message or document with a private key. A digital signature is used to verify the authenticity of the sender and the integrity (unaltered condition) of the message or document. See also *hash*.
Digital Signature Algorithm	See *DSA*.
direct-sequence spread-spectrum	See *DSSS*.
domain	(1) On the Internet, a set of network addresses that are organized in levels. (2) In Microsoft Windows NT and Windows 2000, a set of network resources (applications, printers, and so forth) for a group of users (clients). Clients log into the domain to access the resources, which can be located on a number of different servers in the network.

domain policy	A collection of configuration settings that you can define once in 3Com Wireless Switch Manager (3WXM) and apply to many Wireless Switches (WXs). Each Mobility Domain group in the network has a default domain policy that applies to every WX switch in the Mobility Domain. See also *Policy Manager*.
DSA	Digital Signature Algorithm. The public-key algorithm used to sign X.509 certificates.
DSSS	Direct-sequence spread-spectrum. One of two types of spread-spectrum radio technology used in wireless LAN (WLAN) transmissions. To increase a data signal's resistance to interference, the signal at the sending station is combined with a higher-rate bit sequence that spreads the user data in frequency by a factor equal to the spreading ratio. Compare *FHSS*.
DTIM	Delivery traffic indication map. A special type of traffic indication map (TIM) element in a beacon frame that occurs only when a station in a basic service set (BSS) is in power-save mode. A DTIM indicates that any buffered broadcast or multicast frames are immediately transmitted by an access point (AP).
DXF format	A tagged data representation, in ASCII format, of the information contained in an AutoCAD drawing file.
dual-homed connection	A redundant, resilient connection between a Managed Access Point (MAP) and two or more Wireless Switches (WXs). The connection can consist of two or more distributed links through an intermediate Layer 2 or Layer 3 network. After changing its active link, the access point reboots and loads new configuration information to ensure proper configuration and security. Mobility Domain services are temporarily disrupted by the link change. Dual-homed connections are not required but are recommended. See also *bias*.
Dynamic Host Configuration Protocol	See *DHCP*.

EAP	Extensible Authentication Protocol. A general point-to-point protocol that supports multiple authentication mechanisms. Defined in RFC 2284, EAP has been adopted by IEEE 802.1X in an encapsulated form for carrying authentication messages in a standard message exchange between a user (client) and an authenticator. The encapsulated EAP, also known as *EAP over LAN (EAPoL)* and *EAP over Wireless (EAPoW),* enables the authenticator's server to authenticate the client with an authentication protocol agreed upon by both parties. See also *EAP type*.
EAPoL	EAP over LAN. An encapsulated form of the Extensible Authentication Protocol (EAP), defined in the IEEE 802.1X standard, that allows EAP messages to be carried directly by a LAN media access control (MAC) service between a wireless client (or *supplicant*) and an authenticator. EAPoL is also known as *EAP over Wireless (EAPoW)*. See also *EAP*.
EAP over LAN	See *EAPoL*.
EAP over Wireless	See *EAPoL*.
EAPoW	See *EAPoL*.
EAP-TLS	Extensible Authentication Protocol with Transport Layer Security. An EAP subprotocol for 802.1X authentication. EAP-TLS supports mutual authentication and uses digital certificates to fulfill the mutual challenge. When a user (client) requests access, the authentication server responds with a server certificate. The client replies with its own certificate and also validates the server certificate. From the certificate values, the EAP-TLS algorithm can derive session encryption keys. After validating the client certification, the authentication server sends the session encryption keys for a particular session to the client. Compare *PEAP*.
EAP type	A specific Extensible Authentication Protocol (EAP) authentication mechanism. Both the wireless client (or *supplicant*) and the authenticator must support the same EAP type for successful authentication to occur. EAP types supported in a 3Com Mobility System wireless LAN (WLAN) include EAP-MD5, EAP-TLS, PEAP-TLS, PEAP-MS-CHAP, and Tunneled Transport Layer Security (TTLS). See also *MD5*; *MS-CHAP-V2*; *PEAP*; *TLS*; *TTLS*.
EAP with Transport Layer Security	See *EAP-TLS*.

enabled access	Permission to use all Mobility System Software (MSS) command-line interface (CLI) commands required for configuration and troubleshooting. Enabled access requires a separate enable password. Compare *restricted access*.
encryption	Any procedure used in cryptography to translate data into a form that can be read by only its intended receiver. An encrypted signal must be decrypted to be read. See also *cryptography*.
ESS	Extended service set. A logical connection of multiple basic service sets (BSSs) connected to the same network. Roaming within an ESS is guaranteed by the 3Com Mobility System.
Ethernet II	The original Ethernet specification produced by Digital, Intel, and Xerox (DIX) that served as the basis of the IEEE 802.3 standard.
ETSI	European Telecommunications Standards Institute. A nonprofit organization that establishes telecommunications and radio standards for Europe.
European Telecommunications Standards Institute	See *ETSI*.
extended service set	See *ESS*.
Extensible Authentication Protocol	See *EAP*.
Extensible Markup Language	See *XML*.
failover	In a redundant system, an operation by which a standby (or secondary) system component automatically takes over the functions of an active (or primary) system component when the active component fails or is temporarily shut down or removed for servicing. During and after failover, the system continues its normal operations with little or no interruption in service.
FCC	Federal Communications Commission. The United States' governing body for telecommunications, radio, television, cable, and satellite communications.

FDB	See *forwarding database (FDB)*.
Federal Communications Commission	See *FCC*.
FHSS	Frequency-hopping spread-spectrum. One of two types of spread-spectrum radio technology used in wireless LAN (WLAN) transmissions. The FHSS technique modulates the data signal with a narrowband carrier signal that "hops" in a predictable sequence from frequency to frequency as a function of time over a wide band of frequencies. Interference is reduced, because a narrowband interferer affects the spread-spectrum signal only if both are transmitting at the same frequency at the same time. The transmission frequencies are determined by a spreading (*hopping*) code. The receiver must be set to the same hopping code and must listen to the incoming signal at the proper time and frequency to receive the signal. Compare *DSSS*.
forwarding database (FDB)	A database maintained on a Wireless Switch (WX) for the purpose of making Layer 2 forwarding and filtering decisions. Each entry consists of the media access control (MAC) address of a source or destination device, an identifier for the port on which the source or destination station is located, and an identifier for the virtual LAN (VLAN) to which the device belongs. FDB entries are either permanent (never deleted), static (not aged, but deleted when the WX is restarted or loses power), or dynamic (learned dynamically and removed through aging or when the WX is restarted or loses power).
frequency-hopping spread-spectrum	See *FHSS*.
GBIC	Gigabit interface converter. A hot-swappable input/output device that plugs into a gigabit Ethernet port, to link the port with a fiber-optic or copper network. The data transfer rate is 1 gigabit per second (Gbps) or more. Typically employed as high-speed interfaces, GBICs allow you to easily configure and upgrade communications networks.
gigabit interface converter	See *GBIC*.
glob	See *MAC address glob*; *user glob*; *VLAN glob*.

GMK	Group master key. A cryptographic key used to derive a group transient key (GTK) for the Temporal Key Integrity Protocol (TKIP) and Advanced Encryption Standard (AES).
greenfield network	An original deployment of a telecommunications network.
GRE tunnel	A virtual link between two remote points on a network, created by means of the Generic Routing Encapsulation (GRE) tunneling protocol. GRE encapsulates packets within a transport protocol supported by the network.
GTK	Group transient key. A cryptographic key used to encrypt broadcast and multicast packets for transmissions using the Temporal Key Integrity Protocol (TKIP) and Advanced Encryption Standard (AES).
group master key	See *GMK*.
group transient key	See *GTK*.
H.323	A set of International Telecommunications Union Telecommunication Standardization Sector (ITU-T) standards that define a framework for the transmission of real-time voice signals over IP packet-switched networks.
hash	A one-way algorithm from whose output the input is computationally infeasible to determine. With a good hashing algorithm you can produce identical output from two identical inputs, but finding two different inputs that produce the same output is computationally infeasible. Hash functions are used widely in authentication algorithms and for key derivation procedures.
HiperLAN	High-performance radio local area network. A set of wireless LAN (WLAN) communication standards used primarily in European countries and adopted by the European Telecommunications Standards Institute (ETSI).
HMAC	Hashed message authentication code. A function, defined in RFC 2104, for keyed hashing for message authentication. HMAC is used with MD5 and the secure hash algorithm (SHA).
hashed message authentication code	See *HMAC*.

Hewlett-Packard Open View	See *HPOV*.
homologation	The process of certifying a product or specification to verify that it meets regulatory standards.
HPOV	Hewlett-Packard Open View. The umbrella network management system (NMS) family of products from Hewlett-Packard. The 3Com Wireless Switch Manager (3WXM) tool suite interacts with the HPOV Network Node Manager (NNM).
HTTPS	Hypertext Transfer Protocol over Secure Sockets Layer. An Internet protocol developed by Netscape to encrypt and decrypt network connections to Web servers. Built into all secure browsers, HTTPS uses the Secure Sockets Layer (SSL) protocol as a sublayer under the regular HTTP application layer, and uses port 443 instead of HTTP port 80 in its interactions with the lower layer, TCP/IP. See also *SSL*.
Hypertext Transfer Protocol over Secure Sockets Layer	See *HTTPS*.
IAS	Internet Authentication Service. Microsoft's RADIUS server.
IC	Industry Canada. The Canadian governing body for telecommunications.
ICV	Integrity check value. The output of a message integrity check.
IE	See *WPA IE*.
IEEE	Institute of Electrical and Electronic Engineers. An American professional society whose standards for the computer and electronics industry often become national or international standards. In particular, the IEEE 802 standards for LANs are widely followed.
IGMP	Internet Group Management Protocol. An Internet protocol, defined in RFC 2236, that enables an Internet computer to report its multicast group membership to neighboring multicast routers. Multicasting allows a computer on the Internet to send content to other computers that have identified themselves as interested in receiving it.

IGMP snooping	A feature that prevents the flow of multicast stream packets within a virtual LAN (VLAN) and forwards the multicast traffic through a path to only the clients that want to receive it. A Wireless Switch (WX) uses IGMP snooping to monitor the Internet Group Management Protocol (IGMP) conversation between hosts and routers. When the WX detects an IGMP report from a host for a given multicast group, it adds the host's port number to the list for that group. When it detects an IGMP host leaving a group, the WX removes the port number from the group list.
Industry Canada	See *IC*.
information element	See *WPA IE*.
infrastructure network	One of two IEEE 802.11 network frameworks. In an infrastructure network, all communications are relayed through an access point (AP). Wireless devices can communicate with each other or with a wired network. The network is defined by the distance of mobile stations from the access point, but no restriction is placed on the distance between stations. Stations must request association with the access point to obtain network services, which the access point can grant or deny based on the contents of the association request. Like most corporate wireless LANs (WLANs), which must access a wired LAN for file servers and printers, a 3Com Mobility System is an infrastructure network. Compare *ad hoc network*.
initialization vector (IV)	In encryption, random data used to make a message unique.
Institute of Electrical and Electronic Engineers	See *IEEE*.
integrity check value	See *ICV*.
interface	A place at which independent systems meet and act on or communicate with each other, or the means by which the interaction or communication is accomplished.
International Organization for Standardization	See *ISO*.

Internet Authentication Service	See *IAS*.
Internet Group Management Protocol	See *IGMP*.
Interswitch Link	See *ISL*.
ISL	Interswitch Link. A proprietary Cisco protocol for interconnecting multiple switches and maintaining virtual LAN (VLAN) information as traffic travels between switches. Working in a way similar to VLAN trunking, described in the IEEE 802.1Q standard, ISL provides VLAN capabilities while maintaining full wire-speed performance on Ethernet links in full-duplex or half-duplex mode. ISL operates in a point-to-point environment and supports up to 1000 VLANs.
ISO	International Organization for Standardization. An international organization of national standards bodies from many countries. ISO has defined a number of computer standards, including the Open Systems Interconnection (OSI) standardized architecture for network design.
IV	See *initialization vector (IV)*.
jumbo frame	In an Ethernet network, a frame whose data field exceeds 1500 bytes.
LAWN	See *WLAN*.
LDAP	Lightweight Directory Access Protocol. A protocol defined in RFC 1777 for management and browser applications that require simple read-write access to an X.500 directory without incurring the resource requirements of Directory Access Protocol (DAP). Protocol elements are carried directly over TCP or other transport, bypassing much of the session and presentation overhead. Many protocol data elements are encoded as ordinary strings, and all protocol elements are encoded with lightweight basic encoding rules (BER).
Lightweight Directory Access Protocol	See *LDAP*.

location policy	An ordered list of rules that overrides the virtual LAN (VLAN) assignment and security ACL filtering applied to users during normal authentication, authorization, and accounting (AAA) — or assigns a VLAN or security ACL to users without these assignments. Defining location policy rules creates a location policy for local access within a Wireless Switch (WX). Each WX switch can have only one location policy. See also *location policy rule*.
location policy rule	A rule in the location policy on a Wireless Switch (WX) that grants or denies a set of network access rights based on one or more criteria. Location policy rules use a username or VLAN membership to determine whether to override — or supply — authorization attributes during authentication and to redirect traffic. Location policy rules are processed in the order in which they appear in the location policy. See also *location policy*.
MAC	(1) Media access control. See *MAC address*. (2) Message authentication code. A *keyed hash* used to verify message integrity. In a keyed hash, the key and the message are inputs to the hash algorithm. See also *MIC*.
MAC address	Media access control address. A 6-byte hexadecimal address that a manufacturer assigns to the Ethernet controller for a port. Higher-layer protocols use the MAC address at the MAC sublayer of the Data Link layer (Layer 2) to access the physical media. The MAC function determines the use of network capacity and the stations that are allowed to use the medium for transmission.
MAC address glob	A 3Com convention for matching media access control (MAC) addresses or sets of MAC addresses by means of known characters plus a “wildcard” asterisk (*) character that stands for from 1 byte to 5 bytes of the address. See also *user glob*; *VLAN glob*.
MAC protocol data unit	See *MPDU*.
MAC service data unit	See *MSDU*.

Managed Access Point™ (MAP™)	A small hardware unit that functions as a wireless access point (AP) in a 3Com Mobility System. Using one or more radio transmitters, a MAP transmits and receives information as radio frequency (RF) signals to and from a wireless user (client). The MAP transmits and receives information over a 10/100BASE-T Ethernet connection to and from a Wireless Switch (WX). The WX switch also supplies electrical power to the access point by means of Power over Ethernet (PoE). A MAP communicates with a WX by means of the MAP Control Protocol.
managed device	In a 3Com Mobility System wireless LAN (WLAN), a Wireless Switch (WX) or Managed Access Point (MAP) under the control of the 3Com Wireless Switch Manager (3WXM) tool suite.
MAP	See *Managed Access Point™ (MAP™)*.
MAP Control Protocol™	Managed Access Point (MAP) control protocol. A point-to-point datagram protocol that defines the way each Managed Access Point (MAP) communicates with a Wireless Switch (WX) in a 3Com Mobility System. By means of MAP Control Protocol, MAPs announce their presence to the WX, accept configuration from it, relay traffic to and from it, announce the arrival and departure of users (clients), and provide statistics to the WX on command.
master secret	A code derived from the pre-master secret. A master secret is used to encrypt Transport Layer Security (TLS) authentication exchanges and also to derive a pairwise master key (PMK). See also *PMK*; *pre-master secret*.
maximum transmission unit	See *MTU*.
MD5	Message-digest algorithm 5. A one-way hashing algorithm used in many authentication algorithms and also to derive cryptographic keys in many algorithms. MD5 takes a message of an arbitrary length and creates a 128-bit message digest.
media access control address	See *MAC address*.
message authentication code	See *MAC*.
message-digest algorithm 5	See *MD5*.

message integrity code	See *MIC*.
MIC	Message integrity code. The IEEE term for a message authentication code (MAC). See *MAC*.
Microsoft Challenge Handshake Authentication Protocol	See *MS-CHAP-V2*.
minimum data transmit rate	The lowest rate at which a Managed Access Point (MAP) can transmit data to its associated mobile clients. If the data rate to a client drops below the minimum, the MAP increases power, if RF Auto-Tuning is enabled.
Mobility Domain™	A collection of Wireless Switches (WXs) working together to support a roaming user (client).
Mobility Profile™	A user (client) authorization attribute that specifies the Managed Access Points (MAPs) or wired authentication ports the client can use in a Mobility Domain™ group.
Mobility System Software™ (MSS™)	The 3Com operating system, accessible through a command-line interface (CLI) or the 3Com Wireless Switch Manager (3WXM) tool suite, that enables 3Com Mobility System products to operate as a single system. Mobility System Software (MSS) performs authentication, authorization, and accounting (AAA) functions; manages Wireless Switches (WXs) and Managed Access Points (MAPs); and maintains the wireless LAN (WLAN) by means of such network structures as Mobility Domain™ groups, virtual LANs (VLANs), tunnels, spanning trees, and link aggregation.
MPDU	MAC protocol data unit. In IEEE 802.11 communications, the data unit (or *frame*) that two peer media access control (MAC) service access points (SAPs) exchange through the services of the Physical layer (PHY). An MPDU consists of MAC headers and a MAC service data unit (MSDU). See also *MSDU*.
MS-CHAP-V2	Microsoft Challenge Handshake Authentication Protocol version 2. Microsoft's extension to CHAP. MS-CHAP-V2 is a mutual authentication protocol, defined in RFC 2759, that also permits a single login in a Microsoft network environment. See also *CHAP*.

MSDU	MAC service data unit. In IEEE 802.11 communications, the data payload encapsulated within a MAC protocol data unit (MPDU).
MSS	See *Mobility System Software™ (MSS™)*.
MTU	Maximum transmission unit. The size of the largest packet that can be transmitted over a particular medium. Packets exceeding the MTU value in size are fragmented or segmented, and then reassembled at the receiving end. If fragmentation is not supported or possible, a packet that exceeds the MTU value is dropped.
NAT	Network address translation. The capability, defined in RFC 3022, of using one set of reusable IP addresses for internal traffic on a LAN, and a second set of globally unique IP addresses for external traffic.
network address translation	See *NAT*.
network plan	A design for network deployment and settings for network configuration, stored in the 3Com Wireless Switch Manager (3WXM) tool suite.
nonvolatile storage	A way of storing images and configurations so that they are maintained in a unit's memory whether power to the unit is on or off.
Odyssey	An 802.1X security and access control application for wireless LANs (WLANs), developed by Funk Software, Inc.
OFDM	Orthogonal frequency division multiplexing. A modulation technique that sends data across a number of narrow subcarriers within a specified frequency band. The wireless networking standards IEEE 802.11a and IEEE 802.11g are based on OFDM.
orthogonal frequency division multiplexing	See *OFDM*.
pairwise master key	See *PMK*.
pairwise transient key	See *PTK*.
PAT	Port address translation. A type of network address translation (NAT) in which each computer on a LAN is assigned the same IP address, but a different port number. See also *NAT*.

PEAP	Protected Extensible Authentication Protocol. A draft extension to the Extensible Authentication Protocol with Transport Layer Security (EAP-TLS), developed by Microsoft Corporation, Cisco Systems, and RSA Data Security, Inc. TLS is used in PEAP Part 1 to authenticate the server only, and thus avoids having to distribute user certificates to every client. PEAP Part 2 performs mutual authentication between the EAP client and the server. Compare *EAP-TLS*.
PEM	Privacy-Enhanced Mail. A protocol, defined in RFC 1422 through RFC 1424, for transporting digital certificates and certificate signing requests over the Internet. PEM format encodes the certificates on the basis of an X.509 hierarchy of certificate authorities (CAs). Base64 encoding is used to convert the certificates to ASCII text, and the encoded text is enclosed between BEGIN CERTIFICATE and END CERTIFICATE delimiters.
Per-VLAN Spanning Tree protocol	See *PVST+*.
PIM	Protocol Independent Multicast protocol. A protocol-independent multicast routing protocol that supports thousands of groups, a variety of multicast applications, and existing Layer 2 subnetwork technologies. PIM can be operated in two modes: dense and sparse. In PIM dense mode (PIM-DM), packets are flooded on all outgoing interfaces to many receivers. PIM sparse mode (PIM-SM) limits data distribution to a minimal number of widely distributed routers. PIM-SM packets are sent only if they are explicitly requested at a rendezvous point (RP).
PKCS	Public-Key Cryptography Standards. A group of specifications produced by RSA Laboratories and secure systems developers, and first published in 1991. Among many other features and functions, the standards define syntax for digital certificates, certificate signing requests, and key transportation.
PKI	Public-key infrastructure. Software that enables users of an insecure public network such as the Internet to exchange information securely and privately. The PKI uses public-key cryptography (also known as *asymmetric cryptography*) to authenticate the message sender and encrypt the message by means of a pair of cryptographic keys, one public and one private. A trusted certificate authority (CA) creates both keys simultaneously with the same algorithm. A registration authority (RA) must verify the certificate authority before a digital certificate is issued to a requestor.

The PKI uses the digital certificate to identify an individual or an organization. The private key is given only to the requesting party and is never shared, and the public key is made publicly available (as part of the digital certificate) in a directory that all parties can access. You use the private key to decrypt text that has been encrypted with your public key by someone else. The certificates are stored (and, when necessary, revoked) by directory services and managed by a certificate management system. See also *certificate authority (CA)*; *registration authority (RA)*.

plenum	A compartment or chamber to which one or more air ducts are connected.
plenum-rated cable	A type of cable approved by an independent test laboratory for installation in ducts, plenums, and other air-handling spaces.
PMK	Pairwise master key. A code derived from a master secret and used as an encryption key for IEEE 802.11 encryption algorithms. A PMK is also used to derive a pairwise transient key (PTK) for IEEE 802.11i robust security. See also *master secret*; *PTK*.
PoE	Power over Ethernet. A technology, defined in the developing IEEE 802.3af standard, to deliver DC power over twisted-pair Ethernet data cables rather than power cords. The electrical current, which enters the data cable at the power-supply end and comes out at the device end, is kept separate from the data signal so neither interferes with the other.
policy	A formal set of statements that define the way a network's resources are allocated among its clients — individual users, departments, host computers, or applications. Resources are statically or dynamically allocated by such factors as time of day, client authorization priorities, and availability of resources.
Policy Manager	A 3Com Wireless Switch Manager (3WXM) feature that allows you to apply a collection of configuration settings known as a *domain policy*, or part of the policy, to one or more Wireless Switches (WXs). With Policy Manager, you can also merge some or all of the configuration changes you make to a single WX switch into a domain policy. See also *domain policy*.
port address translation	See *PAT*.
Power over Ethernet	See *PoE*.

pre-master secret	A key generated during the handshake process in Transport Layer Security (TLS) protocol negotiations and used to derive a master secret.
preshared key	See *PSK*.
PRF	Pseudorandom function. A function that produces effectively unpredictable output. A PRF can use multiple iterations of one or more hash algorithms to achieve its output. The Transport Layer Security (TLS) protocol defines a specific PRF for deriving keying material.
Privacy-Enhanced Mail	See *PEM*.
private key	In cryptography, one of a pair of keys, one public and one private, that are created with the same algorithm for encrypting and decrypting messages and digital signatures. The private key is provided to only the requestor and never shared. The requestor uses the private key to decrypt text that has been encrypted with the public key by someone else. See also *PKI*; *public key*.
PRNG	Pseudorandom number generator. An algorithm of predictable behavior that generates a sequence of numbers with little or no discernible order, except for broad statistical patterns.
Protected Extensible Authentication Protocol	See *PEAP*.
Protocol Independent Multicast protocol	See *PIM*.
pseudorandom function	See *PRF*.
pseudorandom number generator	See *PRNG*.
PSK	Preshared key. The IEEE 802.11 term for a shared secret, also known as a *shared key*. See *shared secret*.

PTK	Pairwise transient key. A value derived from a pairwise master key (PMK) and split into multiple encryption keys and message integrity code (MIC) keys for use by a client and server as temporal session keys for IEEE 802.11i robust security. See also *802.11i*.
public key	In cryptography, one of a pair of keys, one public and one private, that are created with the same algorithm for encrypting and decrypting messages and digital signatures. The public key is made publicly available for encryption and decryption. See also *PKI*; *private key*.
Public-Key Cryptography Standards	See *PKCS*.
public-key infrastructure	See *PKI*.
PVST+	Per-VLAN Spanning Tree protocol. A proprietary Cisco protocol that supports a separate instance of the Spanning Tree Protocol (STP) for each virtual LAN (VLAN) in a network and maps the multiple spanning trees to a single tree, to comply with the IEEE 802.1Q specification. See also *STP*.
QoS	Quality of service. A networking technology that seeks to measure, improve, and guarantee transmission rates, error rates, and other performance characteristics, based on priorities, policies, and reservation criteria arranged in advance. Some protocols allow packets or streams to include QoS requirements.
quality of service	See *QoS*.
RA	See *registration authority (RA)*.
radio profile	A group of parameters, such as the beacon interval, fragmentation threshold, and security policies, that you configure in common across a set of radios in one or more Managed Access Points (MAPs). A few parameters, such as the radio name and channel number, must be set separately for each radio.

RADIUS	Remote Authentication Dial-In User Service. A client-server security protocol described in RFC 2865 and RFC 2866. RADIUS extensions, including RADIUS support for the Extensible Authentication Protocol (EAP), are described in RFC 2869. Originally developed by Livingston Enterprises, Inc., to authenticate, authorize, and account for dial-up users, RADIUS has been widely extended to broadband and enterprise networking. The RADIUS server stores user profiles, which include passwords and authorization attributes.
RC4	A common encryption algorithm, designed by RSA Data Security, Inc., used by the Wired-Equivalent Privacy (WEP) protocol and Temporal Key Integrity Protocol (TKIP).
received signal strength indication	See *RSSI*.
registration authority (RA)	Network software that verifies a user (client) request for a digital certificate and instructs the certificate authority (CA) to issue the certificate. Registration authorities are part of a public-key infrastructure (PKI), which enables secure exchanges of information over a network. The digital certificate contains a public key for encrypting and decrypting messages and digital signatures.
Remote Authentication Dial-In User Service	See *RADIUS*.
restricted access	Permission to use most Mobility System Software (MSS) command-line interface (CLI) commands required for viewing status information (**display** commands), except those that list security information in clear text. Users with restricted access can clear ARP requests and ping hosts. Compare *enabled access*.
RF detection sweep	A comprehensive search for radio frequency (RF) signals within a Mobility Domain™ group, to locate rogue clients, rogue access points, and ad hoc users. A sweep can be either a scheduled sweep or a continuous *SentrySweep*™ search. During a scheduled sweep, each included Managed Access Point (MAP) radio sweeps all channels in the IEEE 802.11b/g and 802.11a spectrum. In contrast, SentrySweep operates only on the disabled radios in a Mobility Domain and does not disrupt service.

roaming	The ability of a wireless user (client) to maintain network access when moving between access points (APs).
robust security network	See *RSN*.
rogue access point	An access point (AP) that is not authorized to operate within a wireless network. Rogue access points subvert the security of an enterprise network by allowing potentially unchallenged access to the enterprise network by any wireless user (client) in the physical vicinity.
rogue client	A user (client) who is not recognized within a network, but who gains access to it by intercepting and modifying transmissions to circumvent the normal authorization and authentication processes.
RSA	A public-key algorithm developed in 1977 by RSA Data Security, Inc., used for encryption, digital signatures, and key exchange.
RSN	Robust security network. A secure wireless LAN (WLAN) based on the developing IEEE 802.11i standard.
RSSI	Received signal strength indication. The received strength of an incoming radio frequency (RF) signal, typically measured in decibels referred to 1 milliwatt (dBm).
scalability	The ability to adapt easily to increased or decreased requirements without impairing performance.
secure hashing algorithm	See *SHA*.
Secure Shell protocol	See *SSH*.
Secure Sockets Layer protocol	See *SSL*.
security ACL	Security access control list. An ordered list of rules to control access to and from a network by determining whether to forward or filter packets that are entering or exiting it. Associating a security ACL with a particular user, port, virtual LAN (VLAN), or virtual port on a Wireless Switch (WX) controls the network traffic to or from the user, port, VLAN, or virtual port. The rules in an ACL are known as *access control entries (ACEs)*. See also *ACE*.

seed	(1) An input to a pseudorandom number generator (PRNG), that is generally the combination of two or more inputs. (2) The Wireless Switch (WX) that distributes information to all the WX switches in a Mobility Domain™ group.
SentrySweep™	A radio frequency (RF) detection sweep that runs continuously on the disabled radios in a Mobility Domain™ group. See also *RF detection sweep*.
session	A related set of communication transactions between an authenticated user (client) and the specific station to which the client is bound.
Session Initialization Protocol	See *SIP*.
service set identifier	See *SSID*.
SHA	Secure hashing algorithm. A one-way hashing algorithm used in many authentication algorithms and also for key derivation in many algorithms. A SHA produces a 160-bit hash.
shared secret	A static key distributed by an out-of-band mechanism to both the sender and receiver. Also known as a *shared key* or *preshared key (PSK)*, a shared secret is used as input to a one-way hash algorithm. When a shared secret is used for authentication, if the hash output of both sender and receiver is the same, they share the same secret and are authenticated. A shared secret can also be used for encryption key generation and key derivation.
SIP	Session Initialization Protocol. A signaling protocol that establishes real-time calls and conferences over IP networks.
Spanning Tree Protocol	See *STP*.
SSH	Secure Shell protocol. A Telnet-like protocol that establishes an encrypted session.
SSID	Service set identifier. The unique name shared among all computers and other devices in a wireless LAN (WLAN).

SSL	Secure Sockets Layer protocol. A protocol developed by Netscape for managing the security of message transmission over the Internet. SSL has been succeeded by Transport Layer Security (TLS) protocol, which is based on SSL. The *sockets* part of the term refers to the sockets method of passing data back and forth between a client and a server program in a network or between program layers in the same computer. SSL uses the public-and-private key encryption system from RSA Data Security, Inc., which also includes the use of a digital certificate. See also *HTTPS*; *TLS*.
station	Any device with a media access control (MAC) address and a Physical layer (PHY) interface to the wireless medium that comply with the standards for all IEEE 802 networks. Wireless clients and Managed Access Points (MAPs) are stations in a 3Com Mobility System.
STP	Spanning Tree Protocol. A link management protocol, defined in the IEEE 802.1D standard, that provides path redundancy while preventing undesirable loops in a network. STP is also known as *Spanning Tree Bridge Protocol*.
subnet mobility	The ability of a wireless user (client) to roam across Managed Access Points (MAPs) and Wireless Switches (WXs) in a virtual LAN (VLAN) while maintaining a single IP address and associated data sessions.
supplicant	A client that is attempting to access a network.
syslog server	A remote repository for log messages. 3Com Mobility System Software (MSS) supports up to four syslog servers on virtual LANs (VLANs) whose locations are configurable. MSS log protocol complies with RFC 3164.
Temporal Key Integrity Protocol	See *TKIP*.
TKIP	Temporal Key Integrity Protocol. A wireless encryption protocol that fixes the known problems in the Wired-Equivalent Privacy (WEP) protocol for existing IEEE 802.11 products. Like WEP, TKIP uses RC4 ciphering, but adds functions such as a 128-bit encryption key, a 48-bit initialization vector, a new message integrity code (MIC), and initialization vector (IV) sequencing rules to provide better protection. See also *802.11i*; *CCMP*.

TLS	Transport Layer Security protocol. An authentication and encryption protocol that is the successor to the Secure Sockets Layer (SSL) protocol for private transmission over the Internet. Defined in RFC 2246, TLS provides mutual authentication with nonrepudiation, encryption, algorithm negotiation, secure key derivation, and message integrity checking. TLS has been adapted for use in wireless LANs (WLANs) and is used widely in IEEE 802.1X authentication. See also *EAP-TLS*; *PEAP*; *TTLS*.
TLV	Type, length, and value. A methodology for coding parameters within a frame. *Type* indicates a parameter's type, *length* indicates the length of its value, and *value* indicates the parameter's value.
Transport Layer Security protocol	See *TLS*.
TTLS	Tunneled Transport Layer Security. An Extensible Authentication Protocol (EAP) method developed by Funk Software, Inc., and Certicom for 802.1X authentication. TTLS uses a combination of certificates and password challenge and response for authentication. The entire EAP subprotocol exchange of attribute-value pairs takes place inside an encrypted transport layer security (TLS) tunnel. TTLS supports authentication methods defined by EAP, as well as the older Challenge Handshake Authentication Protocol (CHAP), Password Authentication Protocol (PAP), Microsoft CHAP (MS-CHAP), and MS-CHAPV2. Compare *EAP-TLS*; *PEAP*.
Managed Access Point Control Protocol	See *MAP Control Protocol*™.
Tunneled Transport Layer Security subprotocol	See *TTLS*.
tunneling	The transmission of data by one network through the connections of another network by encapsulating its data and protocol information within the other network's transmission units. To forward traffic for a roaming user within a Mobility Domain™ group, a Wireless Switch (WX) that is not a member of the user's virtual LAN (VLAN) creates a tunnel to another WX switch on which the user's VLAN is configured.
type, length, and value	See *TLV*.

U-NII	Unlicensed National Information Infrastructure. Three unlicensed frequency bands of 100 MHz each in the 5 GHz band, designated by the U.S. Federal Communications Commission (FCC) to provide high-speed wireless networking. The three frequency bands — 5.15 GHz through 5.25 GHz (for indoor use only), 5.25 GHz through 5.35 GHz, and 5.725 GHz through 5.825 GHz — were allocated in 1997.
Unlicensed National Information Infrastructure	See *U-NII*.
user	A person who uses a client. In a 3Com Mobility System, users are indexed by username and associated with authorization attributes such as user group membership.
user glob	A 3Com convention for matching fully qualified structured usernames or sets of usernames during authentication by means of known characters plus two special “wildcard” characters. Double asterisks (**) represent *all* usernames. A single asterisk (*) can appear either before or after the delimiter in a user glob and can represent any number of characters up to the next delimiter. A delimiter can be an *at* (@) sign or a dot (.). See also *MAC address glob*; *VLAN glob*.
user group	A collection of users with the same authorization attributes.
vendor-specific attribute	See *VSA*.
virtual LAN	See *VLAN*.
VLAN	Virtual LAN. A set of ports that share a single Layer 2 network. Because the ports that constitute a VLAN can be on a single network device or multiple devices, VLANs enable you to partition a physical network into logical networks that meet the needs of your organization. You can divide a single device into multiple logical Layer 2 switches, with each VLAN operating as a separate switch, or make multiple devices members of multiple logical Layer 2 networks. By default, all Wireless Switch (WX) ports are members of VLAN 1, which is named *default*.

VLAN glob	A 3Com convention for applying the authentication, authorization, and accounting (AAA) attributes in the location policy on a WX switch to one or more users, based on a virtual LAN (VLAN) attribute. To specify all VLANs, use the double-asterisk (**) wildcard characters. To match any number of characters up to, but not including a delimiter character in the glob, use the single-asterisk wildcard. Valid VLAN glob delimiter characters are the *at* (@) sign and the dot (.). See also *location policy*; *MAC address glob*; *user glob*.
Voice over IP	See *VoIP*.
VoIP	Voice over IP. The ability of an IP network to carry telephone voice signals as IP packets in compliance with International Telecommunications Union Telecommunication Standardization Sector (ITU-T) specification H.323. VoIP enables a router to transmit telephone calls and faxes over the Internet with no loss in functionality, reliability, or voice quality.
VSA	Vendor-specific attribute. A type of RADIUS attribute that enables a vendor to extend RADIUS operations to fit its own products, without conflicting with existing RADIUS attributes or the VSAs of other companies. Companies can create new authentication and accounting attributes as VSAs.
watch list	A 3WXM method for monitoring user location and activity. After initially finding a user through 3WXM, you can add the user to the watch list for continued monitoring. 3WXM tracks and displays such information as the Managed Access Point(s) (MAP(s)) that a user is associated with during a session, the server that authenticated the user, and the session start and stop times.
Web View	A Web-based application for configuring and managing a single Wireless Switch (WX) and its attached Managed Access Points (MAPs) through a Web browser. Web View uses a secure connection that implements Hypertext Transfer Protocol over Secure Sockets Layer (HTTPS).
WECA	Wireless Ethernet Compatibility Alliance. See *Wi-Fi Alliance*.

WEP	Wired-Equivalent Privacy protocol. A security protocol, specified in the IEEE 802.11 standard, that attempts to provide a wireless LAN (WLAN) with a minimal level of security and privacy comparable to a typical wired LAN. WEP encrypts data transmitted over the WLAN to protect the vulnerable wireless connection between users (clients) and access points (APs). Although appropriate for most home use, WEP is weak and fundamentally flawed for enterprise use. Compare *AES*; *CCMP*; *TKIP*.
Wi-Fi Alliance	An organization formed by leading wireless equipment and software providers, for certifying all IEEE 802.11 wireless LAN (WLAN) products for interoperability and promoting the term *Wi-Fi* as their global brand name. Only products that pass Wi-Fi Alliance testing can be certified. Certified products are required to carry an identifying seal on their packaging stating that the product is Wi-Fi certified and indicating the radio frequency band used (2.4 GHz for 802.11b and 5 GHz for 802.11a, for example). The Wi-Fi Alliance was formerly known as the *Wireless Ethernet Compatibility Alliance (WECA)*.
Wi-Fi Protected Access	See *WPA*.
wildcard mask	A 32-bit quantity used with an IP address to determine which bits in the address to ignore in a comparison with another IP address. When setting up security access control lists (ACLs), you specify source and destination IP addresses and corresponding wildcard masks by which the WX switch determines whether to forward or filter packets. The security ACL checks the bits in IP addresses that correspond to any *0*s (zeros) in the mask, but does not check the bits that correspond to *1*s (ones) in the mask.
wired authentication port	An Ethernet port that has 802.1X authentication enabled for access control.
Wired-Equivalent Privacy protocol	See *WEP*.
Wireless Ethernet Compatibility Alliance	See *Wi-Fi Alliance*.
wireless Internet service provider	See *WISP*.

wireless LAN	See *WLAN*.
Wireless Switch™ (WX™)	A switch in a 3Com Mobility System. A WX provides forwarding, queuing, tunneling, and some security services for the information it receives from its directly attached Managed Access Points (MAPs). In addition, the WX coordinates, provides power to, and manages the configuration of each attached MAP, by means of the MAP Control Protocol.
WISP	Wireless Internet service provider. A company that provides public wireless LAN (WLAN) services.
WLAN	Wireless LAN. A LAN to which mobile users (clients) can connect and communicate by means of high-frequency radio waves rather than wires. WLANs are defined in the IEEE 802.11 standard.
WPA	Wi-Fi Protected Access. The Wi-Fi Alliance's version of the Temporal Key Integrity Protocol (TKIP) that also includes a message integrity code (MIC) known as *Michael*. Although WPA provides greater wireless security than the Wired-Equivalent Privacy protocol (WEP), WPA is not as secure as IEEE 802.11i, which includes both the RC4 encryption used in WEP and Advanced Encryption Standard (AES) encryption, but is not yet ratified by IEEE. See also *AES*; *RC4*; *TKIP*.
WPA IE	A set of extra fields in a wireless frame that contain Wi-Fi Protected Access (WPA) information for the access point or client. For example, a Managed Access Point (MAP) uses the WPA IE in a beacon frame to advertise the cipher suites and authentication methods that the MAP supports for its encrypted SSID.
WPA information element	See *WPA IE*.
WX™	See *Wireless Switch™ (WX™)*.
X.500	A standard of the International Organization for Standardization (ISO) and International Telecommunications Union Telecommunication Standardization Sector (ITU-T), for systematically collecting the names of people in an organization into an electronic directory that can be part of a global directory available to anyone in the world with Internet access.

X.509	An International Telecommunications Union Telecommunication Standardization Sector (ITU-T) Recommendation and the most widely used standard for defining digital certificates.
XML	Extensible Markup Language. A simpler and easier-to-use subset of the Standard Generalized Markup Language (SGML), with unlimited, self-defining markup symbols (tags). Developed by the World Wide Web Consortium (W3C), the XML specification provides a flexible way to create common information formats and share both the format and the data on the Internet, intranets, and elsewhere. Designers can create their own customized tags to define, transmit, validate, and interpret data between applications and between organizations.

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